Knowledge and /Truth

Are these two important?

Context: see Papers (menu) or LinkedIn (intro) or WP post (content).

Green – LLW comments
Blue – JMS - original response to comments
Red – JMS - later response

This article continues a series that started with "Artificial Intelligence, not solely machine learning" (Linkedin, TruthEng). What we discussed before pertains to how ML highjacked (or attempted to highjack) AI. We, the humans involved, want AI back. The 1st article briefly looked at a few of the important topics: AI and Lisp; Knowledge-based engineering (KBE); and how the Boeing 777 development project involvement with KBE contributed to the start of the discipline. Basically, the notion is that ML needs KBE, and its like, for many reasons which we will discuss.

> Larry: Good start.

From its start, KBE proved to offer useful supplemental resources and processes to the computing of the time. Though continued use, sometimes, with other names, KBE progressed tremendously over the past two decades. We can look at the current situation in the light of KBE and discuss the future from perspectives of truth.

> Larry: Added word in red. Deleted 4 unnecessary words in last sentence.

Coming articles will address these topics: Physicalness; More on mathematics; ML's emergence and surge; and Data and decisions. That last topic will use a patent related to data science as its framework for discussion.

> Larry: Good.

Now, in the following sections (below and in subsequent articles), the material is independent but ties cohesively with the other topics. The necessary relations between the topics will be discussed later. Now, we are setting up the framework for future discourse that has meaning and actionable attributes.

Larry: Modified 1st sentence which was clumsy.

Today, we will look at these three:

Twins and more – We know nature having been, as a species, here for a long time. Individually, we have learned. Collectively, we used science for knowledge. The computer? It was an artifice of our prowess with artifacts. But, it was all natural. Now, we have something that comes to "life" on the computer that requires us to change our thinking. We have not done this yet. It's about time.;

Larry: above paragraph is headed (Twins), but never mentions what they are about. Do we need a sentence of two discussing why they are mentioned?

These are labels of the three sections. So, it's like a reference before definition.

Engineering – We change the world. Usually, it's by hook and crook. Engineering is a discipline that changes the world with our approval. Sometimes we enjoy the change; other times not. But there are mechanisms to handle the change. We just witnessed two decades of uncontrolled change with impacts that we have not understood yet. The latest? Open AI's little sand-boxy thing. So, engineers might know nature to an extent; they don't know computing as it ought to be known.; and

KBE now – This is a framework to apply computing to the processes and thinking of engineers. It's newish, having started in the 1980s/90s. Some thought it had a winter with the other Ais in the 1990. We are here to show that KBE did not and is quite alive and doing well. Albeit, KBE is not the only "moniker" being used. So, we'll look at that.

Larry: The tie-in between Engineering and KBE is well done. Twins seems to be left out.

Next section.

Twins and more

In the context of this article which extends several threads related to AI (as it ought to be discussed), a useful concept to consider is “digital twin” which has widespread usage, nowadays. Though, at the same time, some might be recoiling from the use of “digital” as we used it three decades ago. And, the word has been overused and misused. We can ignore that controversy for now and put the concept to good use.

Essentially, we are talking about things that are physical (in the world of nature as are we humans) having corresponding computational models related to them. That thing on the computer can be called the twin whether in the aggregate or with respect to some part. There are many varieties of twins to consider, but we will look at the types provided by KBE.

> Larry: I generally follow the 2 above paragraphs.

Skipping over a bunch of details, we could say that photos of a person can be the start of a twin on the computer. We all know that would be very superficial, but one might wonder given some uses today (photos created by generative means is an example). As we know, a “digital” twin of a person would be a huge affair. The question to keep in mind, how close could such a twin come to the reality of that which it is twinning?

> Larry: Replaced ‘give’ with ‘created’. Dropped 6 words in same sentence.
>
> Larry: Would you say one of our expert systems is a twin of the expert we worked with?

I see the “twin” as the model that is computationally framed. Then, the mode for the representation would be along the line of the object oriented. In this way, we would have entities with descriptors as required. Then, the entity would exhibit behavior via the methods (processed) defined for it. If you have watched or done games of the advanced nature, you see that the relationship to our physical knowledge is getting better handled. Though, one knows the artificial nature of the game’s entities.

At the same time, one would be able to use procedural programming. In fact, some like to create a “god” entity which provides the means for handling universal issues. Not unlike the Common (if I remember correctly ;>) command that FORTRAN allowed. But, universals step on the need for

partitioning and information hiding. Yet, there are OS level (analog) things that one wants to do in order to set up a run properly. Part of the setup up would arrange defaults in cases where the user did not specify any, let's say.

Somewhat, I would think of the expert system being used to drive decisions which result in action. One motivation for machine learning is to allow a more automated approach to handling new data and adjusting the "expert system" thereby. KEE was object oriented. The rules ran again

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Twin here refers to a digital type. It could be robotic, in the future. An "avatar" is a low order twin, in a sense. But, we're talking something functional. Take a drone, with sensors, being driven by computer. The model on the computer would represent the drone, its attributes and abilities, including some mapping on the computer that directly ties to the sensor.

The issue, mainly? Territory/map. That which is twinned is the territory. Whatever is involved with twinnng is the map. It's easy to conflate these two and lose perspective.

DOD has made this error with their emphasis on simulation being the proxy of reality. As I said, they blow things up. In our realm, we need the full-blown modeling that respects people who are more intricate than the matter they subsume and exhibit energetics far beyond what physics handles.

Wait, this was being written with engineers in mind who would have had the exposure though they may not agree with my take on the issues.

Okay, let us take one of these cars that are self-driving. It would have a twin (let's say, somewhere in a conglomerate of devices that compute) which knows a lot of information about the auto that its twinning. The use of the plural here is to acknowledge that we are in an age of disparately located devices where distributed means help provide a type of coherent whole.

Let's make two things clear. The auto is in the world. It is one thing. And, it is our creation and has properties that we can assess. We will call it, henceforth, that which is twinned: **Twt**. Now, to get to showing our points, we have to talk about **Twt** and the twin{s) that have been created for it. We would like to use **Din**. So,

we will be talking about **Twt** and how it came about as well as at the **Din(s)** and what they entail. For ease, let us just use **T** and **D**, respectively, for these two. Again, the former is the one with natural physicalness. The latter is about our abilities to create artifacts on the computer. But a twin could have access to information about physical aspects of the **T** and even have physicalness itself. For now, we will keep it simple and punt the more complex variety to later.

> Larry: The example above confuses me. Maybe I don't understand your perspective. Related questions:
>
> - Have we twinned an auto (an inanimate object) or an expert driver?
> - I believe we have twinned an expert driver.
> - Then – it is more powerful than an expert driver because it is directly connected to a number of sensors (like 'superpowers').
> - You may think of this twin as KBE. I would call it an Expert System.
>   - I think you called it Din above.
> - What do you think?

Larry, we have some differences on opinion. I watched these things, especially the semis, on the road and was appalled that they were let loose on the road with such lax oversight.

Remember, we are talking a seriously modified car. Not only were there put in means to automate control, loads of equipment went in related to sensing and control, including an on-board computer(s) for some of the processing. So, the twin relates to this car. It moves using the same means that it does when a driver is giving the command. Now, there will be on-board and off aspects in the twin (in the cloud – let's use that for the service coming from the computer) that mimic the driver (it's a different twin). Two twins. One deals with the piece of matter than can run you over. The other deals with a human who if following the rules and protocols would go 1M miles without incident. And, be fully conscious during that time. Those two twins are doing sophisticated mathematics (we can get into that) in a local mode trying to replicate what the driver might be doing which is possible in terms of control: acceleration, braking, turning, … But, cognitive issues? They did not have the bandwidth for this. So, it's machine learning based. We know the limits of this approach.

I say don't believe in sensors, no matter that the press says? They're an engineering marvel. But, they have issues; science will continue to be necessary. Lots of them. DOD knows more than we, but as Jakstis always pointed out to me, the requirements for DOD and for the general public were hugely different, especially in terms of the hardware.
BTW, KBE was into simulation, too (have you seen the recent story on the robot riveter going awry?). I hear you about "expert" being used. But, until we have some semblance of a framework within which these things (twins) will be embedded and influence directly, they're machine learning artifacts. Wait, that was our original take on the matter with KBS. But, KBE never got into that as we were assisting top-notch engineers solve hard problems using the facilities brought forth by AI research.
Trying to replace a driver would be idiotic. BTW, I drove a couple of times in low-level jobs. That's probably one factor here that differs. I spent ten years, almost blue collar, except I did my work and a lot of the bosses (pro bono – mainly for experience). I was in a mode where I wanted to follow my own thoughts without having oversight – my work was usually such as to allow me the freedom of thought). So, here I am. Unusual.
I probably have a deeper concern for workers that you might feel. The computer has made it worse as we have seen develop a very insidious and downright awful overlay of dominance. You know, the factory floor example of people being driven by systems written by those who have never done the job. Stupid. Officers come up through the ranks.
The 777? Had design-build teams. We pulled the engineers and mechanics into one room. The computer helped. Like analyzing a design for human factors issues that were concerning. It worked.

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Again, simulation was an early type of the object oriented. However things are depicted, the idea is to have code following intuitive notions so as to enhance the human who is using the computer. Lisp was great about allowing whatever was necessary via its macro facility. I used macros but did not write any. And, we had several of the variety that modeled parts and subparts. So, in a sense, a part could be anything. If we talked a set, then it's members would be parts and named such. The "defpart" allowed the

naming. ICAD handled the referencing. Still today, there are debates about whether OO brings anything. It may not in the scale-driven mode of CompSci. But, they don't resolve domain problems. That situation needs flexibility.

Both concepts are new as opposed to our human selves (for which we will use **H)** which are old hat to many. At some point, we will have to address further issues related to the issues of philosophy (grounding), psychology (many factors) and general humanness (with western civilization as a focus). There is the need to provide a reasonable framework for the discussion which will anticipate the coming downturn and work to keep KBE properly going into the future.

Larry: Does it work think of the Din as a human with superpowers?

- Processing speed is one superpower – computer is way faster than humans.
- Removal of emotions is another – computer sticks to its logic.
- Ability to deal with complexity – expert drivers are way better than average.
- Magnified sensory skills – computer tied directly to many sensors.

Again, there are types of powers. I am trying to stay away from those that we might discuss which map to anthropological attributes. So, the computer is a fast abacus, yes. Dig down? It's stupid at the core. As you know. Now, emotions? They're part of our framework and actually facilitate reasoning. There is nothing like a pure logic machine that is worth anything. You know, Larry, logic can prove anything. Hence the conflicts. Oh yes, with respect to drivers, they do more than merely pay attention and reason. Defensive driving? It's still the norm. The auto auto people never even addressed that. They want to get to edge computing where everything talks to everything thereby hoping to remove incidents that occur due to entities not being on the same page, so to speak. But, then, the computational load goes haywire. And, sensor? Again, they of limits. We know that and try to define things such that those factors not important go away. But, they don't. Pareto was not a friend. He and his ideas have been misused and abused. BTW, same goes for math which is a tautological nightmare at its core. We cannot rely on that, either. Truth engineering? See the motivations? They're without end. I mentioned truth maintenance to Gemini, and it got thrilled. In our day, with KEE, TMS was seen as too hard to compute. Nope, KBE handled it with smart adjustments. Now? ML

hides this with flimflam choices like reducing word size and using the data to drive decisions. Data as crap? Yes, the road to perdition is being paved by Nvidia.

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Funny. Djinn, in the Koran, deals with spirits (like angels doing God's work). I thought of that. So, we're talking effusions from buckets-of-bits (these are the BoBs defined in the next article – I split this one out). But, Musk joked about conjuring the demons. You know, Maxwell had an example. So did Wigner. People think this way. But, we're really not dealing with "creatures" per se.

Computers are not faster than humans. I can show this. BTW, logic is suspect and very much not able to support life. Bayes knew that. Yes, I'm talking expert driver, too, which I am. We read situations in ways that are not mere handling of e-m input. Some of this might be anticipation related to notions touched upon by non-verbal behavior analysis. Let's just say that it's humans doing their best. I mentioned philosophy. I'm not off the wall.

Western civilization went off course. I like that we have Hindus coming to fore here. But, they're enthralled with materialism. Too bad. Not really. It's a chance for them to have this type of learning, too. Again, all of that's in the background.

KBE allowed me to do real work and look at these dualities while pondering the history of how people handled them. Right now, I'm reading Levi-Civita who was right there when this approach (that is, the latest manifestation of the technical approach) was taken up by Einstein. Nvidia is trying to do tensors more efficiently.

But, crap a million times faster is just that, except it can make our lives more difficult.

So continuing, the two artificial entities (**T** and **D**) offer an interesting mix. The former is like any auto but has additional equipment on board: sensors; actuators; and processing power to handle local computing needs. Too, it is tied operationally to something on the cloud (**C**) that supports the situation of trying to handle incoming data (all sorts) plus make decisions. On the other hand, the latter (computing milieu) is that which provides to the **C** piece the various facilities which support operational situations. But it is more as it can mimic

(digitally) properties of the **T** thing. As well, **C** is an entity of vast proportions in its own right. Pieces of **C** get into action via various schemes that go back to the beginning of computing. Thank us for avoiding that right now.

> Larry: As noted above, to me, we 'twin' an expert driver, not the auto. And, the expert driver has superpowers due to speed of computing plus access to sensors. Does this make sense?
>
> Larry: This makes me wonder what you mean by phsicalness?

It's not a typical auto. And, it's doing the driving according commands by the watcher (who might be your expert driver). Let's say that it's like an OS. It would still belong to the car as that is the milieu. It knows nothing of being a human. And, a driver show is human has attributes not being considered.

This is the middle-out concern. I am noting that the car has lots of the controls built in. Say, smart controls. Smart sensors. &c (using Levi-Civita's symbology). As such, it learns via ML and experience. But, it also is a packaged whole.

So, let's go another direction. The D (as mentioned above, could be the car or the driver – we'll assume the former as doing the latter is harder than these people know how to handle – perhaps, could not anyway – and, none of these even thought that way as their resolving mathematically framed situations) is a twin of an increasingly sophisticated car. Think of the fighter jet. They're made to be unstable by design (have you seen discussions of that?). Why? The humans can handle the complexity and learn how to maximize their use of the unstable factors and do so quite effectively. If there were artificially defined stability in place? It would be cumbersome. The car could be the same way.

On the other hand, the space shuttle had periods where the computer ran the thing. Reentry. But, those were predefined situations. Not so much a priori, but they could be modeled.

But, with the car, we need attention and awareness. If we had a human involved, the human could provide that and then request that the (newly configured) car do something. The car would then obey within all of the constraints that apply at that moment. You see, different mode entirely. There would be on-board and remote pieces of the twinning. So, the car is (can be) twinned with or without a human.

BTW, racing is somewhat like the fighter jet pilots go through. Scaled down car that is highly responsive. The drivers learn how to control.

To the meat? Physicalness. I used the potential to run someone over. Now, the car can do that. By will? Not really. Even considering all of the different sets of apparatus aboard, there is nothing doing a cognitive look alike (now). It has no means to run one over.

Aside: recently, a person was killed by one of the factory robots. It either went outside of the safe region (where the thing will not venture), the safe region was not defined right, the human got outside of the safe region, or such. So, the robot didn't kill the person. It just caused physical damage to the body that was outside of expectations and that proved to be fatal.

And this goes for the cloud. There is nothing in the twin that is computed in origin that is physical. You mentioned, uses energy. The computer does. The twin? Not. It's a conglomeration of side effects. Of course, there are the buckets-of-bits. And, there are models of actuators. And models of sensors. There's nothing physical about the model. So, it can control something that is physical. Sure. Like printing. Side effect.

Beside, Larry. We are dealing with massive numeric processing here. That's done in parallel as much as possible. Then, the system code. It's distributed. We were toying with this back in the '80s. The cloud? Distributed to the core. Any process, could be "physically" in any number of pieces of the computers.

This has gone so far that the notion of computing is entirely different than what we saw back in the day. I mentioned drilling down to some machine state. We don't have that anymore.

So, some BoB which is a collection of effusions from heated matter (the chip and board level) might have physicality. But, there is no mapping that would make sense. I think that we need to get back to that. The decisions of the past two to three decades have been very ignorant of important elements related to knowledge.

I was going to mention analog earlier. Now, this approach actually uses states of nature in order to determine factors and decisions based upon them. So, there is definitely a tie.

Digital is wishing. See the next paragraph. It said that the T can run you over. Not the D, or the computer. Now, someone could conk you on the head fatally with a computer. Those old ones, like my early Toshiba. It's of the style that had gone up mountain climbing.

So, physical has to do with natural being. We'll get smarter about that, too. I used effusions. Gas is physical. But, the effusions of the computer? How would you describe it? Making these effusions produces heat and other things. But, much of those other things are mere changes of state to matter via the imposition of 0 and 1 so as to record the state.

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Larry, for now, we can say that I am addressing issues from the classical side of things. That would mean the use of intuitive notions related to the western view. That is, the world view for which use of the Renaissance is apropos. We see entities. They're unique. At some level, we expect this of pieces of a system. Humans can be conjoined, but there is sharing of organs when they are not separate. … At some point, we'll get to the quantum view. At that level, Pauli came to the rescue with his exclusion principle which states that electrons cannot share attributes. Usually. Mainly, the concern is to avoid having two things in an inseparable mode. Of course, who can see at that level. But, the principle allows work to be done and predictions to be made.

Squasing? I mentioned this with ML. Yes, they lose nuance associated with differentiating things. Another term I use is homogeneous. In that sense, anything of a set can replace another. Again, who cares with electrons? Same goes for other elements. Except we may very well. Down the pike, truth engineering will bring up this discussion. It's alluded to a time or two.

We have physicalness. Most things modeled and twinned have physicalness. Now, a novel? It might occupy a set of printed papers pulled together as a book, but that which the symbols represent is not physical. One might argue that the book represents the novel and be close enough.

But, we are not dealing in things where idempotency is assumed when we deal with fairness and justice. Essentially, the whole of computing is off the mark. You were upset that I dissed automation. I'm not a Luddite but really do

bemoan the absence of any quality concern. A major factor? Watch people. Not many get themselves into their work as if they care. I did. I wasn't alone. And, the guys on the street (or should I say bar?) who are being left behind by this new, ignorant worldview that cannot recognize the value of work for people (beyond getting food)? They loved to work. I know. I did 10 years of blue/off-whitish work across the board. it definitely influenced my take on matters.

The main crux now? The auto (**T**) is real enough to run you over. That's sufficient to know. The twin (**D**) is via **BoB**s various ways. And, **H** can have several roles, such as driving the **T**, playing around with the interface with **T** and **D**, being the main brain behind the scheme, and such. Or, **H** can be like me and having observed the idiocy of some trucks on the road wants to tell people about it. Oh, yes, the thing would not pass a test if I designed the thing. Too, those brainy types on board? Go talk to some 1,000,000 safe drivers and, perhaps, a lot more. This stuff was not Silly-Con valley at its finest.

Larry: But an expert driver (T) will not run you over.

Larry: This sentence (The twin (**D**) is via **BoB**s various ways.) is confusing.

Larry: Did Silicon Valley screw or is self-driving as good or better than the average driver?

We had this concept called vertigo and used it a lot. That's where processes, both logic and numeric, get lost. It's nothing new. The workaround is to have routines do things like pause, look for interrupts, etc. Yet, stack up decision requests, and things go awry fast. Sheesh, ATT through fatfingering shut off their mobile systems (let's hope that they offer a refund for costs accrued during the outage). Microsoft with their infamous blue screen of death? Oh yes, we can figure that there were billions of accrued costs that companies just ate. AI? It's causing dumb choices; people will been over backwards to get the thing to work. Yes, we could go on about this for a long time.

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Larry, I watched many of these trucks. In many cases, if someone had watched the truck during a test of a human, he/she would not have passed. The most funny? The traffic was approaching an incline. I could see that; the truck could not. I was behind. It went over to the left to pass the vehicle ahead of it. And,

as I expected, the thing slowed down. We see some drivers do this if they underestimate the incline. So, I continued to go so as to pass on the right as there was plenty of room for me to get back on the left. Again, I could see the level of incline and knew that it would slow down even further. But, the thing accelerated almost as if it were in a race, as it wanted to pass me and get back on the right. In short order, we were above the speed limit going up. The thing did not back off. I could perceive potential problems due to the traffic and slowed down. It passed me and got in the right lane. Of course, then I could pass it on the left and keep going up the hill. Ann and I saw lots of examples like this as a company was regularly running on certain roads. I learned how to identify them by the configuration.

So, they are not better than a driver. It's a stupid carrying out to reality, notions from computer games. We're fortunate that there weren't more accidents. Luck. That would run out.

This goes for many automated vehicles (all types). I always pay attention. You can sense the computer "thinking" (funny, again) and making an idiotic decisions. I ask people, who see it, where are the rules from control engineering? Well, ML (xNN) cannot get to the type of generalizations needed. We can show that. Minsky went to his grave arguing with these folks.

Back to business, one can see that the mixtures are vast. Each needs some attention which is what engineering brings to the table. So, this piece of the puzzle? Engineers have been doing their part, from what I can see. Thank them. Even those involved with the auto-auto as they're dealing with sensors, actuators, and other essential parts needed for progress.

In the meantime, we have to talk about change and its agents. Engineering is all about change. We all do that sort of thing. However, for public affairs, we have assigned the duty to degreed engineers, usually accompanied with a requirement for licensing. Naturally, there are others who make change, but engineers are related to the KBE that we are discussing. And, we need to get engineering in all aspects into AI; they can tame ML's overreach, one would hope.

Larry: Excellent paragraph –above.

Finally, there are uses of engineering that are not kosher. Financial type? This was not a gift from MIT.

> Larry: This paragraph is confusing. Either explain the issue or drop the paragraph.

You mentioned derivatives. Buffett used to bemoan them. He's silent now as he has found a way to make money. Which you can. Ill-begotten gains. … MIT gave us the modeling to do the dumb program trading and a lot more.

Oh yes, the huge climb of Nvidia. Shows the ca-pital-sino in action. No mature, reasonable economy would allow that crap. AIn't is of the same ilk. And, we can resolve this if we got mathematicians out of their "cloud" (which is unnecessary).

Engineering

Formally, engineering deals with applied science, at its core, abetted by mathematics. In the common sense, there are several other connotations of the term. As said, we all engineer when being creative (Note 1). And, engineering is the one discipline that regularly changes the world in ways that have allowed us to enjoy (or not) the results. In the practice of engineering, "trades" (some use trade-offs) are a common occurrence dealing with the complexities of choice. Most decisions are not "yes or no", nor do they reduce themselves down to mere consideration of easy alternatives. As we will see, KBE was (still is) a superb framework for supporting many types of decision.

> Larry: Rewrote phrase in red above.

Business deals with tradeoffs, too, with different jargon and motives. However, we address these from the underlying framework of human decision making as it pertains to all aspects of technology. We saw, in the past couple of decades, PhDs in Physics (and the like), who were grounded more into mathematics than most business types, come over to finance. Want to know the truth? It is a mess now. One word is all that we need about causal issues: ca-pital-sino (neologism created by the author). Take that as a cursory mention for later discussion: "engineering" had a big hand in the mess.

> Larry: Yes, the man who created 'derivatives' in banking refused to let his bank use them in practice.

Some of this was Chase. They did the tranching scheme. I told Ann this: it's taking a bunch of crap, gold plating it, slicing it into pieces and then selling these pieces. Countries failed with this stupidity – being sold as cash equivalent. So, they have levels. Guaranteed return all the way to highly risky. But, the tranching split across the good and the bad (more of this). I wrote several posts on this. The thing is that on the failure, some piece of supposed value (toxic) had 100 or so claims on it. They had to unwind this, figure who got paid and who did not. Messy.

BTW, about Nvidia? On the rise, it's phony value. That's why there is such a fall and so quickly. Yet, people take out the value (leaving milk of white color and no fat). That leaves the rest hold pieces of less value. We see this time and again. I'm talking the ca-pital-sino (supposed investors; what is real is that we have gamblers, some addicted). Okay. Look at the other side. What? Nvidia is $2T or so? Debt? Have you paid attention? Forget the National debt. Think credit cards. Want to now what the quantity of this is? $2T or even more. Guess what? In the stock side, it crashes; one loses ones money (unless one was of the fortunate few who sold when they could – that is, had a buyer). Debt? Does not go away. Think of that. We need to teach people that debt is never an asset.

Okay, after that introduction to the complications in store, we are limiting ourselves to core issues and who knows what else that is related. Is there anything more core than quantum mechanics (QM) outside of human issues? In that realm, which we will get to in the future, mathematics plays a heavy role. In

fact, it has the heaviest of roles for the gloried discipline. The history of QM illustrates that early experiments allowed some observations of the traditional type. That is, those of the eye-ball types were possible, with crude instruments. But technology got better, as did instrumentation. Behind technology, we can discuss the mathematics and how it (with group theory being a very good example) turned out to be important to QM.

We might say that the use of "**D**" came to be, whether mathematical or, later, digital. QM demonstrated the cojoining of the nature (being researched) with its twins (our devices). We all know of the remarkable results of this pairing. We may have seen some of the downside. Mostly, those are on the planet of our existence (species loss, as noted by biology). So there is a limit to how far we can address the bad effects. Along another line, computation is just beginning and is too new to show us its true value assessment (good and the bad).

> Larry: These two QM paragraphs seem to open a mystery with no conclusion.

> Larry. What's behind QM? Mathematics. Tightly so. And, it's wrong. And, they're playing with Q computers. Guess what? Errors are far worse than what you might have seen. It's a major problem. I'm trying to raise to sight some serious problems that CompSci does not care about as they only worry of the academic issues of complexity and such (paper subjects). We are talking reality. Oh yes, that's why I used physicalness. We're in a physical world. Lots of what we've done has screwed up the world. Time to mature. …

Now, nature and its twins? Another term came to fore by necessity. What we are referring to is "physical state" which denotes that which the twin is not. The twin? It is not physical. What nature provides is so definitely. Stepping up to the cloud, and the AI (or ML), there is a physical piece, say buckets-of-bits (BoBs is what we can use). The main output is not physical, except by side-effect as we have noted. It has no mass, does not really use energy, and, seemingly, is ephemeral (try to touch it). The final things of computing are of the mind (that is, the human). And, psychology will come into play, later (again, stay tuned). May we take this further?

> Larry: Does it really not use energy? Thought ML used a lot of power.

Larry, very good. It gave me pause. Let's say, I've switched between classical and quantum modes in this. Engineers don't like that. They're too linear. Whereas, the nature of reality is full-blown and infinite. We need to talk about that. Brouwer even noted that there was some use for the concept. Yes, the BoBs use the energy and have physicalness. The twins and all things computed? Nope.

Now, if you're willing, we could discuss this type of thing. So, the side-effects could be seen as attributes. In fact, they're not unlike bringing in the complex numbers which have been used so many ways, including in ML.

As an aside, in the future, your comment brings in issues of information theory (Shannon) and even thermodynamics. This first pass was a high-level attempt to mention some of the important factors.

KBE Now

In the prior article, we mentioned that getting involved with an ICAD project was our introduction to KBE. The common trait with earlier work was the Lisp language of John McCarthy. However, the problem set of engineering was a delightful surprise. Not only is the discipline broad, mathematics plays a huge part. As well, there is a long history of solutions that come along from those who worked in the discipline. At the time, only some of this had been brought to the computer.

Larry: Excellent paragraph.

The situation with engineering and computing was a lot different than we think about now. It was not long before, when slide rules were seen everywhere. At the time, mainframes were the big servers. There were many other types of computing that were specialized. In terms of engineering, lots of effort had gone into creating workstations. These were mostly targeted to specific types of engineering. For instance, electrical engineers had sophisticated systems due to their type of work dealing with the intricacies of analysis and design. Computer-aided design at the time required a workstation that was tied to the data source on a mainframe. The workstation had facilities for handling geometry and performing actions on such.

Larry: Excellent.

On the other hand, a civil engineer later said that the business office of his company had better equipment than did his engineers involved with the construction work of his company, some of which was quite involved (commercial buildings of large proportion).

Larry: ok.

Be that as it may, in 2022, the focus on KBE seemed to have switched to overseas as searches returned little U.S. activity; yet, quick searches pulled many international papers to the fore. The puzzlement was that we observed KBE as being basic to truth engineering research (Note 2) a couple of decades ago, for which computing's role was a key discipline. Getting to know the "generative" ways, as proposed and demonstrated by the ML crowd, in 2023, had an impact of priority. KBE was back to being on the table plus there was concerted effort to dig deeper to see what had transpired over the last two decades.

Larry: Implies US is falling behind in the foundational computing area.

The U.S. has an interesting history and role. Melting pot. Canada is still of the UK, more or less. Mexico never got over its Spanish influence. Same goes for the Central and South American areas.

One thing that I would bring in? The native Americans, norte variety. This has to do with psychology and sociology. That will help balance the dynamics of the melting pot.

There is a lot to report, we can quote Scott Heide who worked for ICAD while at the MIT AI lab. He was there in the day of the Lisp machine as an early employee. Scott's current firm, Engineering Intent, exemplifies ICAD leanings, as we can see with their rule focus (Rule authoring in Knowledge Bridge). In Scott's words:

> While nobody has come up with the perfect name for the technology, it has had a number of monikers: rules-based engineering, knowledge-based engineering, engineering automation, engineering decision-support.

Larry: Very good paragraph + quote.

After seeing this quote, further searches about the current status of KBE used the other concepts. Generally, in these additional sources, KBE was mentioned but was not prominent. Basically, given the amount of activity, one might argue that

AI never had a winter since there had been lots of progress over the past two decades. Recently, U.S. DOD presented its guidelines for digital engineering. A recent conference was loaded with details about the modern ways, some of which emphasize the importance of good models of physics and the advantages of simulation. To be thorough, we mention some firms dealing with matters related to KBE: Infosys, Ansys, and Paramcs. This is a very small sample. There definitely was no "AI" winter; albeit, we have seen several economic downturns related to other

> Larry: Paragraph has not ending '.' – and lost words??
>
> Larry: Expert Systems were 'hot' from mid-80s to early 90s. They now seem to be dead – an extreme form of winter.

I noticed that. There may be a backup copy that has it.

Larry, on academia.edu, I have seen lots of recent Expert Systems papers. They're from all over. It's like the current generation is waking up. So, we were doing KBE in the 2000s and even up to now where it's configured merely as a template affair. As I mention, many doing other things, still mention KBE.

I haven't heard from that author. Doesn't matter. I'll explain.

With respect to the above discussion about the **D** and **T** (remember them?), there are several things to discuss further. Simulation has really improved and is now a major factor in analysis. Of course, what of the **D** types we are referring to, since nature itself is being mimicked with computing. We could use this definition:

> computing is using our ideas about electromagnetic and other phenomena via our configuring matter and controlling energy related to such to bring about side-effects that we find useful.
>
> Larry: Good.

Along this same line, the topics of sensors and actuators, especially with regard to robotics which may be augmented with AI, will be both interesting to watch but, at the same time, will require more critical analysis using types not seen yet. That's on the long list of future topics.

> Larry: Ok.

Coming topics, again

In short, there is no end to the associative links to other topics. KBE has always been within the framework for research in truth engineering. As such, it is operationally demonstrative. Additionally, we must bring in the factors that go beyond mere show and tell. Coming articles will address some of these as they are very many – say, the total sum of knowledge associated with a university and its intellectual heritage (**H** talents/knowledge plus artifacts). The claims of those pushing the "generative" modes seem to suggest that there might be a search for "omni" status (science, potence, etc.). We want to establish a reasonable basis for why the claim might be (is) suspect. Further topics to set the stage for discussion are: physicalness; more on mathematics; ML's emergence and surge; and data and decisions. The latter is related to demonstration with a patent as the initial focus (Note 3). But to be mentioned everywhere will be KBE.

Larry: Excellent ending.

Notes:

1. Education -- traditional school of liberal arts and sciences (University) with a major in quantitative/mathematical economics. Though not an engineer, I have worked in engineering support via advanced computational systems all of my professional life (was always using expensive equipment). So, I can reference things observed, professionally and culturally, in enough of a manner without being too specific. Necessary details can be filled, if required. Then, during the past two decades, I have studied what I call "truth engineering" which came out of my work experience, especially KBE. My focus for self-study (autodidacts offer educated views outside of the peer structure – analog is custom made versus off-the-shelf as we see with software) was the basis for western civilization and its current glory which is engineering. In this context, "study" means a scope of top to bottom with a special emphasis on mathematics and how it has evolved. At the same time that I was doing my study, of course, the world changed into being heavily reliant upon computing,

perhaps inordinately. And, watching this was part of my activity. The changes led to problematic issues of major proportion. This series will consider how KBE can help us handle our current dilemmas. Larry: Excellent.

2. AI or ML -- After OpenAI's release, I started to look at ML. Of course, issues were recognizable, immediately. After all, it was merely a continuation of the past two decades. I contacted my old employer (Larry Walker) at Sperry Univac's Knowledge Systems Center (KSC). Larry filled me in on his computing history which goes back to the early systems in roles that were both technical and managerial. We both agreed that circumstance ruined a good thing. Actually, we are both of the mind that the evolution of AI would have been different had KSC continued its work. I had gone to Boeing after the KSC and discussed my experiences with KBE with Larry. Obviously, my work was a continuation with the different twist of being directly involved with engineering. Larry: Very good.

3. **Systems and methods for filtering and smoothing data**, US7139674B2, Switlik and Klein