

Recursion—or, Better Computational Thinking Through Laughter

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One of the predictable side effects of writing this column is that on a regular basis—at least several times a year—I am compelled to come up with a topic, a computational diversion. I would like to pretend that this process is structured, impeccably organized, planned months in advance; but as anyone who knows me could attest, things just do not work out that way. The result is that I am periodically on the lookout for some subject matter that could make for a column—and more especially, a subject that has not already been done to death in recreational math circles.

Last weekend, I was in this sort of quietly panicked condition when I took my 7-year-old son to see the animated movie *Kung Fu Panda*. (We both enjoyed it.) At one point during the cartoon, the title creature is excitedly taking an introductory tour of his martial arts school, marveling at all the ancient kung fu-related artifacts; and he comes upon a beautifully rendered Chinese painting. The panda exclaims, “I’ve only seen paintings of that painting!”

The line brought an appreciative laugh from the audience (including, interestingly, the children as well); and it occurred to me that there might be a relatively unexplored subject for discussion in this. After all, there is currently a push in computer science circles to promote “computational thinking” (a notion whose definition is itself energetically debated). At the same time, one of the purportedly difficult topics in computational thinking is mastery of the idea of recursion. The panda’s line—and the laugh that it received—suggests that people already have an aesthetic sense of the oddness or appeal of recursive thinking. And the panda’s line is, undeniably, recursive: once you have seen a painting of a painting, you could see a painting of a painting of a painting, and so forth. Recursion is funny, in many senses of the word. I am not entirely sure why this is so: after all, conditionals, and while loops, and compound data structures, and variables are not especially funny. But recursion is.

Since arriving at this insight, I have been trying to collect a variety of instances in literature, plays, movies, to illustrate this sort of enjoyably emotionally charged computational thinking. I ask readers to help me in adding to this collection, and will print

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appropriate additions in a future column. For now, I will mention a few initial exhibits in what might eventually grow to be an entire museum of fun-and-strange recursive images.

We may as well begin our investigation the same way that everyone begins a research project these days—namely, with the Wikipedia website. Interestingly, under the heading “Recursion,” there is indeed a small section on recursive humor. The standard tongue-in-cheek definition of the term is mentioned:

Recursion

See: Recursion.

The Wikipedia entry also mentions the use of recursive acronyms such as GNU (“GNU’s Not Unix”).

These examples employ direct self-reference, an instance of “tail recursion” (recursion to implement an infinitely-running loop). Not all recursive jokes or witticisms have quite so pure, or so intellectual, a form. Recently, in the heat of the current American presidential contest, the comedian Dennis Miller accused Senator Barack Obama’s campaign of playing the “‘race card’ card”—i.e., of unfairly accusing critics of “playing the race card” (Jackson 2008). In response, of course, I could just as well accuse Miller of playing the “‘race card’ card” card—that is, unfairly accusing Obama of accusing others of playing the race card. (And readers sympathetic to Miller might accuse me of playing the [[race card] card] card, where the brackets are intended to help those folks who might be losing track.)

This is an instance, like the Kung Fu Panda’s painting, not of tail recursion but of the clear possibility of an infinite stack of nested references. Two additional instances from the wonderful humor publication *The Onion* illustrate this principle to perfection. One article, headlined “New Remote Control Can Be Operated By Remote”, shows a photograph of an obviously lazy man lounging in a chair and using a small remote device to operate a remote television controller sitting on a table. (The ultimately-controlled television is not shown.) The article begins:

TOKYO—Television watching became even more convenient this week with Sony’s introduction of a new remote-controlled remote control.

The new device, which can be controlled via remote control through the use of a second remote control unit, will replace older models that needed to be held in the hand to be operable. (www.theonion.com/content/node39226)

A more recent *Onion* article, headlined “Apple Unveils New Product-Unveiling Product,” describes the fanciful “iLaunch” application, and begins:

SAN FRANCISCO—At a highly anticipated media event Tuesday at San Francisco’s Moscone Center, Apple Inc. CEO Steve Jobs introduced a new Apple product he said would “revolutionize” the process of unveiling new products throughout the world.

“In 1984, Apple introduced the Mac,” Jobs said to an overflowing crowd as an image of the first Macintosh computer was displayed on a giant screen behind him. “We changed the face of the music industry with the first iPod in 2001. And in January, we showed off the revolutionary new iPhone. Today, Apple is releasing a piece of innovative new technology that will forever change the way innovative new technology is released.” (www.theonion.com/content/news/apple_unveils_new_product)

The recursion here has a flavor of self-reference (that last-quoted sentence is a tiny masterpiece of the genre), but it is not tail recursion. One could keep going with third-order remote controls, or software to launch new product-launching software systems.

There are undoubtedly many similar examples to be found. Yet another such infinite-regress image, similar to the iLaunch, occurs in the movie *Austin Powers: International Man of Mystery*. In one scene—I'm recalling this from memory, so the details may be a bit hazy—the actor Robert Wagner portrays an evil henchman who is using a large map on a table to illustrate for his boss the extent of their organization's holdings. As he speaks, he uses little plastic factories, placing them on the map to indicate manufacturing capabilities. He concludes the presentation by placing one of the factories on the map, saying that it represents a factory that makes little plastic factories. (Granted, this isn't as perfect as the *Onion* images, though I suppose one could create factories that help produce plastic-factory producing factories.) Perhaps a more apt example of the recursive principle—though, rather than funny, it could be more accurately called delightful—is from Dr. Seuss's classic children's book *The Cat in the Hat Comes Back*, in which the titular cat unveils a smaller cat-in-a-hat ("Little Cat A") standing on his head underneath his hat. Little Cat A then unveils a still smaller cat ("Little Cat B"), underneath whose hat is Little Cat C, and so on, through the alphabet. The cats get smaller and smaller, and eventually, apparently, occupy a scale that approaches the atomic (Seuss 1958).

These examples are not meant to suggest that the vein of purely self-referential humor is played out. For those who follow stand-up comedy, it shouldn't be too surprising to see Steven Wright's name appear in a column of this sort. In one routine, Wright describes a scene in which he uses his car to give a ride to a hitchhiker:

A red light on my dashboard came on. My passenger asked, "What's that?" I said, "Don't worry about it—That's just to tell whether or not that bulb is working."

It's interesting, as a side note, to observe how often technology comes up in these examples (remote controls, software, car dashboards). Another famous self-referential machine is the auto-destruct mechanism on the bomber jet in Stanley Kubrick's film *Dr. Strangelove*. (Midway through the film, the jet is damaged, and one of the crew reports, "The auto-destruct got hit and blew itself up.")

For those readers, protective of their dignity, and uncomfortable with the popular level of examples cited so far, it should be remembered that the point is simply to note that recursion is hardly such a rarefied idea as it's often made out to be. (By contrast, for example, one doesn't see too much Galois-theory-related humor.) Nonetheless, one might well try to expand the list with classic examples. The general idea of a "play-within-a-play" shows up repeatedly in Shakespeare: the famous example is in *Hamlet*, but in other plays (*A Midsummer Night's Dream*, *Henry IV Part I*) the technique is used for more straightforwardly comic effect. Similar themes of plays-within-plays, stories-within-stories, narratives-within-narratives, crop up often in classic sources, though the recursive nature of their construction is not always highlighted. *The Arabian Nights* moves back and forth through levels of storytellers, while Plato's *Symposium* effortlessly guides the reader through multiple layers of speakers. (By the time we get to Socrates' recollection of the words of Diotima, we are about four layers of narration deep.)

More recent literary examples of recursion would include the example of the 1:1-scale map imagined by the Argentine writer Jorge Luis Borges in his story "On Exactitude in Science":

In that Empire, the Art of Cartography attained such Perfection that the map of a single Province occupied the entirety of a City, and the map of the Empire, the entirety of a Province. In time, those Unconscionable Maps no longer satisfied, and

the Cartographers Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it. (Borges 1998)

The brilliant writer Steven Millhauser, in his most recent collection of stories *Dangerous Laughter* (Millhauser 2008), takes this notion one insane notch still further in the tale of “The Other Town.” Here, a small town is mirrored by a meticulously-kept full-sized replica just outside its borders, in which all the original town’s objects are arranged and rearranged constantly to keep the accuracy of the copy constant. Naturally, in both Millhauser’s case and Borges’, the possibility of continued recursion is latent: can the full-sized map of the empire include itself? Might the “other town” be accompanied by its own “second-level other town” to further perfect the mirroring process?

Before we finish, an essay of this sort would be incomplete without a mention of Douglas Hofstadter’s fascination with recursion in his various books and essays. One could spend an entire column analyzing Hofstadter’s many references to recursion, but for our purposes we might note, again, the humorous side of the concept that keeps surfacing. In his book *Metamagical Themas* (Hofstadter 1985, pp. 512–513), an imaginary “coffeehouse conversation” on the notion of the Turing Test ends with the exchange:

CHRIS: If you could ask a computer just one question in the Turing Test, what would it be?

SANDY: Uhhh...

PAT: How about this: “If you could ask a computer just one question in the Turing Test, what would it be?”

And finally, a challenge to readers: can you expand this list? If you know of good examples of recursive thinking—particularly with a humorous or joyful flavor to them—by all means, send in examples. Or perhaps you can come up with new recursive jokes yourself; that would be even better. Please send to ijcml-diversions@ccl.northwestern.edu. If I do not hear from you, then this sentence could be the last one ever written on the subject.

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