[JAVA]

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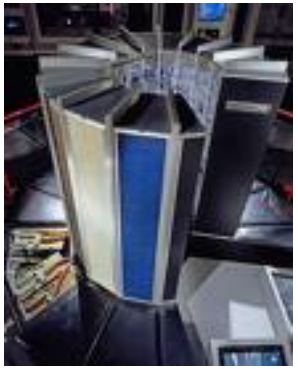
Computation

- A ***computation*** is a sequence of well-defined operations that lead from an initial starting point to a desired final outcome.
  - note this definition does not include the word “computer”
  - a computation is a ***process*** that can be carried out by a person or a machine
  - the same computation might be carried out using any one of a number of different technologies



Example: Average Age

- As an example of a computation, suppose we want to know the average age of a group of students
  - in this case “average” means “arithmetic mean”
  - method: compute the sum of the ages, then divide by the number of students
- For a small group one could use paper and pencil or a hand calculator
- For larger groups (e.g. average age of entering freshman class) one would probably use a computer

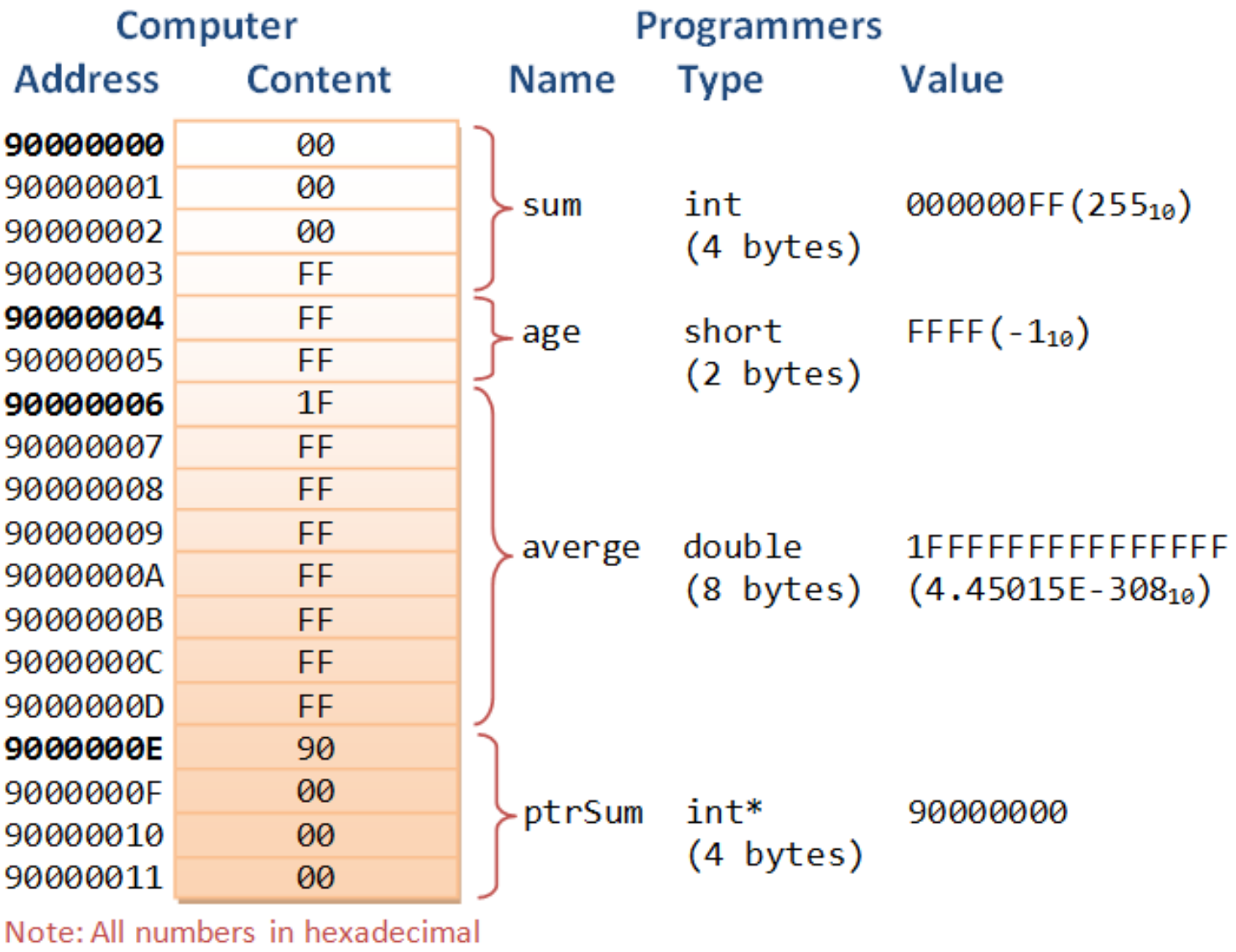
Today's Date: Oct 1, 2008

Sanchez, Maria	Feb 14, 1988	20
Sanders, Eric	Mar 24, 1978	30
Sato, Noriko	Oct 14, 1989	18
Singer, Fred	Apr 30, 1983	25
Smith, John	Feb 26, 1990	18

Average (Mean) Age:

$(20 + 30 + 18 + 25 + 18) \div 5 = 22.2$

Memory as Array

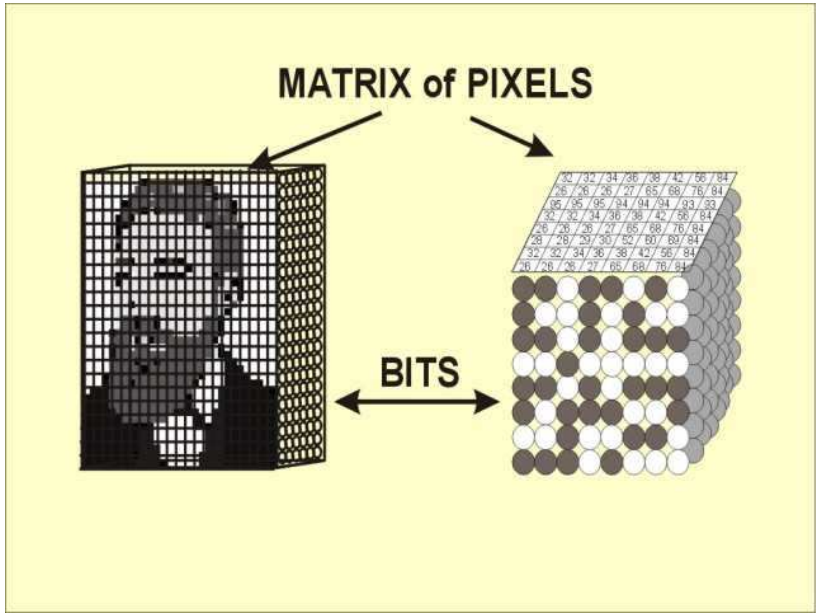


Note: this picture is appropriate for a 32-bit, big endian machine.

How did I know that?

Representing Data

To store data of type X, someone had to invent a mapping from items of type X to bit strings. That's the *representation mapping*.

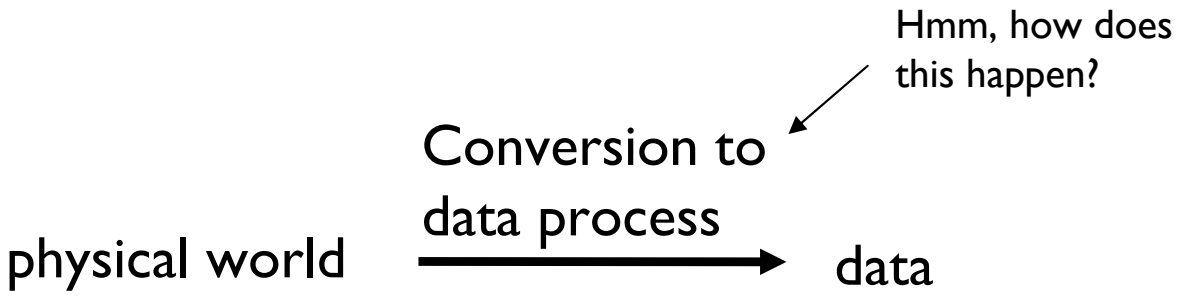


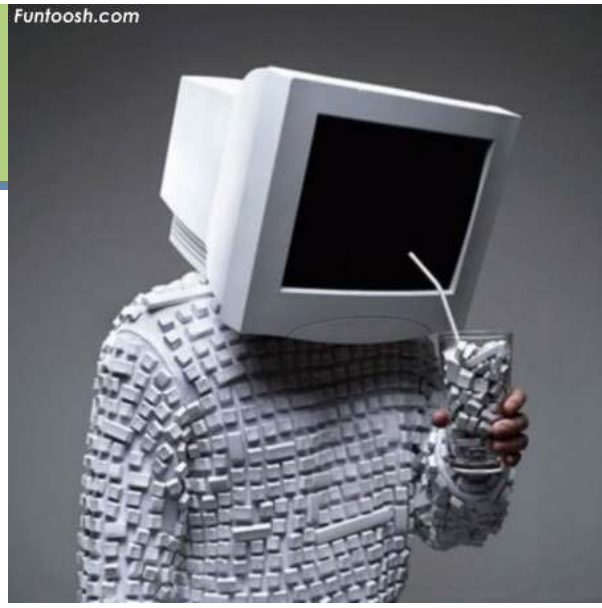
In a sense the representation is *arbitrary*. The representation is just a *mapping from the domain onto a finite set of bit strings*.

But some representations are better than others. Why would that be? Hint: what operations do you want to support?

Computers and Data

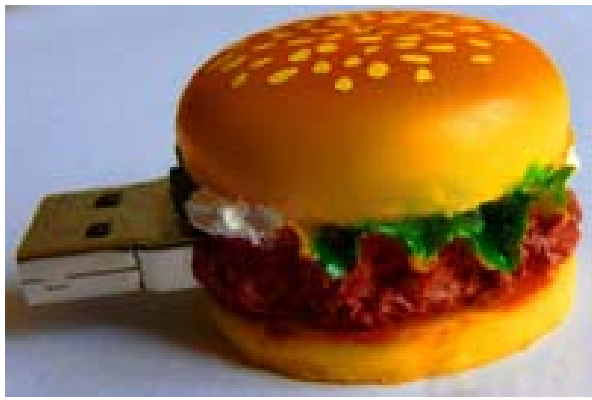
- A digital computer can only perform computation on **data**
  - That is, a computer cannot directly perform computation on the real, physical world
  - The physical world must first be **converted into data**
  - A computer thus performs computation on a **representation** of the physical world
- But, how, exactly, does one **convert** the real world into data?





www.funtoosh.com/pictures/funny_picture.php?id=646

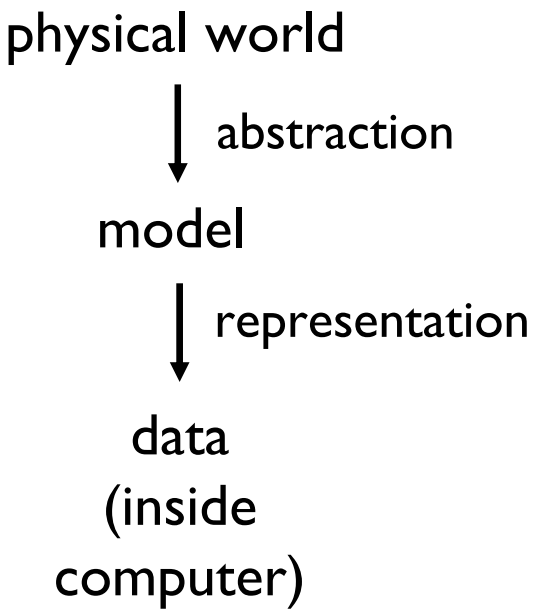
Um, that's data (storage) represented as a physical food, not physical food represented as data…



www.hotfrog.com.au/Companies/Zap-Computers/Novelty-USB-Hamburger-Drive-125634

Abstraction and Models

- Converting the real world into data:
  - Create a **model** of the real world
  - **Represent** that model in **data**



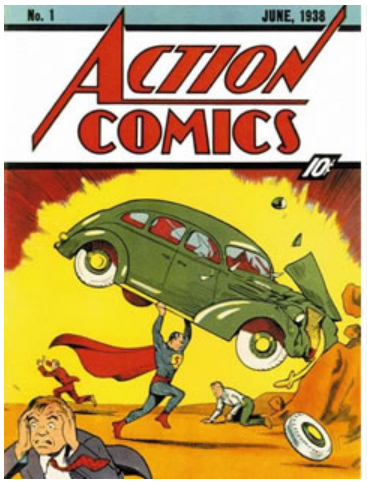
- How do you model the real world?
  - Involves a process called **abstraction**

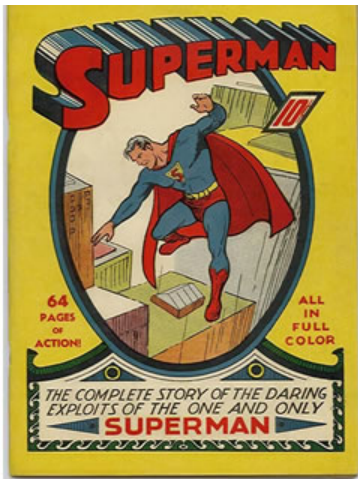
- **Abstraction**
  - Prerequisite: know your problem or application
  - **Focus** on aspects of the real world that are **important to the problem**
    - Add those elements to your model
  - **Omit** elements of the real world that aren't relevant
  - Implies: the same real world scenario can be modeled in many ways, depending on the problem at hand

Modeling Superman

- Let's model the very first Superman comic book

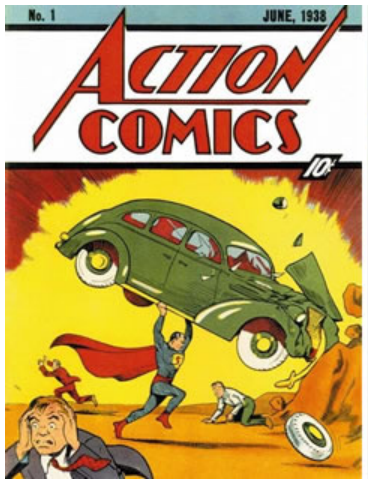
- First, what is our problem?
  - How about, reading the comic on a computer screen?
    - It is important to see the text, pictures, and page layout
    - So, these must be in the model
  - We can **model** the comic book as a set of page images
  - Can **represent** the page images using the Portable Document Format (PDF)
    - Or, alternately, could represent as a series of PNG, JPEG, or GIF images

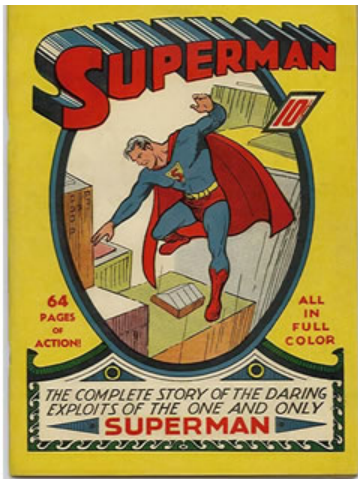




Modeling Superman (cont'd)

- OK, now let's change the problem.
- New problem: have the computer speak aloud the dialog in the comic strip
  - It is important to have the text of the dialog so that the computer can convert it into voice
  - Not important: actual images of the comic (let's assume the reader/listener has the comic in front of them)
  - We **model** the comic strip as a series of frames, each containing the dialog of the characters
  - We **represent** this model as a list of frames, where each frame has text that represents the dialog said by each character
    - Frame 1
      Superman: "I will get you, evil dude!"
      Evil Dude: "Eat kryptonite, caped spandex-boy"





Modeling Superman: observations

- From the same physical situation (a comic book) have two separate models
  - Page-focused model: for problem of reading on computer
    - Emphasizes images over machine-readability of dialog text
  - Dialog-focused model: for problem of reading dialog out loud
    - Emphasizes machine readability, not images at all
- But, recall that the model is not the same as the real, physical system
  - It is just an **abstraction** of the physical system