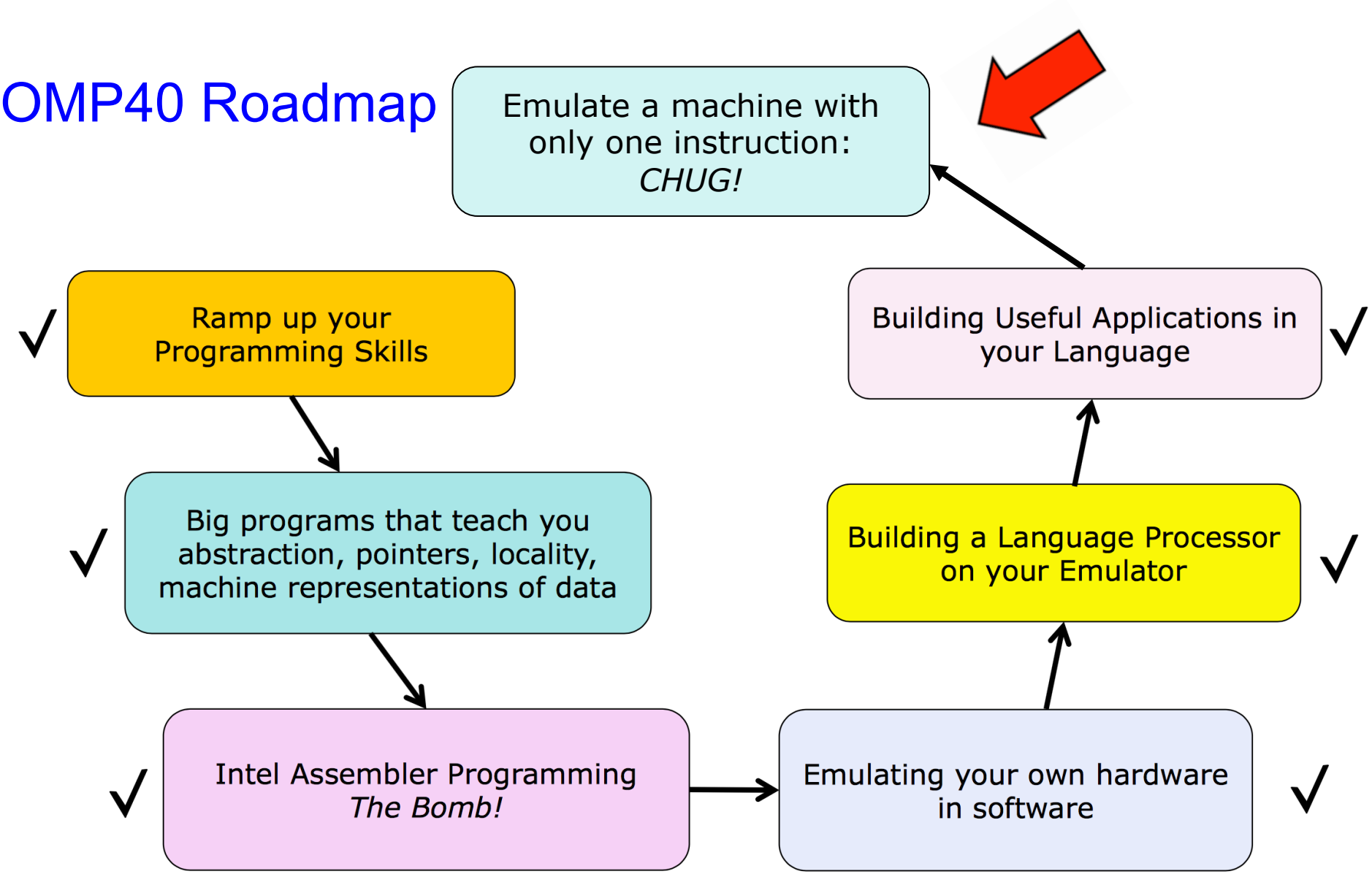
COMP 40: Machine Structure
And
Assembly Language Programming (Spring 2017)

40sfor40: A Malt Liquor Machine

Disclaimer: Not official COMP40 lecture material.

COMP40 Roadmap



Disclaimer: Not official COMP40 lecture material.

Introducing
40s for 40

40s for 40 highlights

- **Bottled (lack of) memory architecture.** Memory is organized into bottles, each containing forty ounces of premium malt liquor.
- **1 simple instruction.** Transfers an amount of liquid from bottled-memory to a register and halts when all bottles are empty (see instruction set semantics)
- **General purpose registers,** with varying capacity between 40 and 80 ounces.

Instruction set

- **One instruction, with opcode 0: *chug* (*and halt if empty*).**
- **Formally, takes a destination register, immediate value (amount to chug), and bottle from which to chug.** We might think of it this way in register transfer language (RTL):

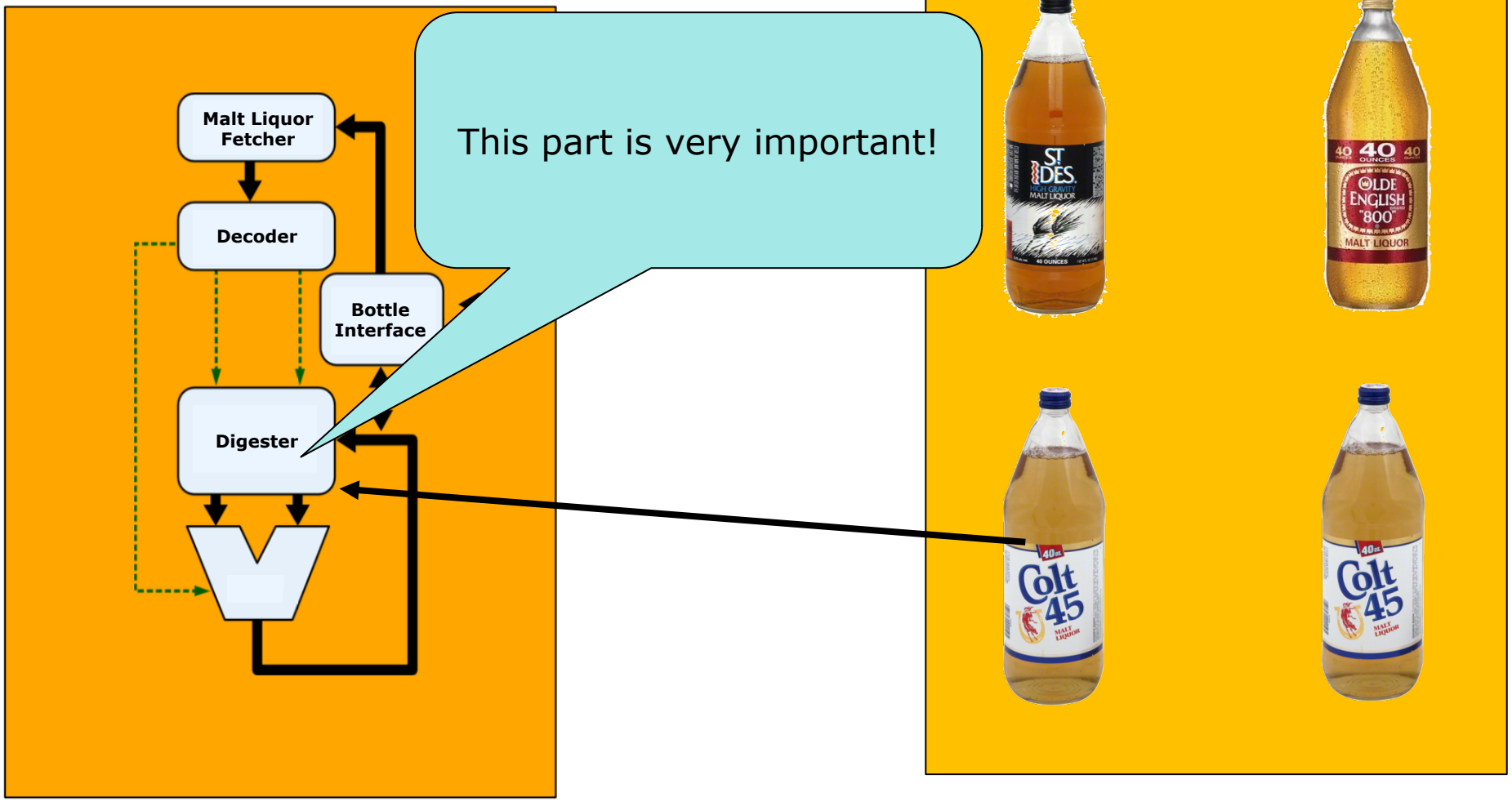
```
m[BOTTLE] := m[BOTTLE] - AMOUNT_TO_CHUG
r[DEST] := AMOUNT_TO_CHUG
```

- **If *all bottles in memory are completely empty,*** the machine halts successfully.
- **Can we can perform arbitrary computation using only this instruction?**
  - Could you implement subtraction? Negative numbers? What about a `GETLIT` macro?

What we expect of you

- **Your design document:**
  - *Very good* design documentation describes succinctly whether you plan on consuming 40 or 80 ounces of malt liquor. You may submit either `DESIGN` or `design.pdf`.
- **Your implementation (due May 10 at the Spanish House):**
  - The biggest task by far is to *choose a representation for bottles.* Common choices include `Olde_English_800_T`, `Colt_45`, and `St_Ides`.
  - Within these choices, there are both glass and plastic options (we recommend the safety and ease-of-use of plastic abstractions).
  - **Keep in mind your choice of brand** can affect performance by as much as 420%!

A simplified view of the machine



Example of a program run in the machine

Initial machine state: registers Joanne, Bob, Amanda
Initialized to zero and 3 full bottles in memory.

```
chug Joanne,2,4
chug Joanne,2,4
chug Joanne,2,4
chug Joanne,2,10
chug Bob,0,8
chug Bob,0,10
chug Amanda,1,40
chug Joanne,2,18
chug Bob,0,22
```

All the bottles are empty, execution stops!

Important things to keep in mind

- **Most experienced C programmers can understand the 40sfor40** specification in a couple of minutes, and can implement the machine in just a few hours following the final exam.
- **History footnote *(from Wikipedia)*:**
  - The term "malt liquor" is documented in England in 1690 as a general term encompassing both beer and ale. The first mention of the term in North America appears in a patent issued by the Canadian government on July 6, 1842, to one G. Riley for "an improved method of brewing ale, beer, porter, and other maltliquors."
- **Most importantly,** have *fun*, be *responsible*, and be *safe*!