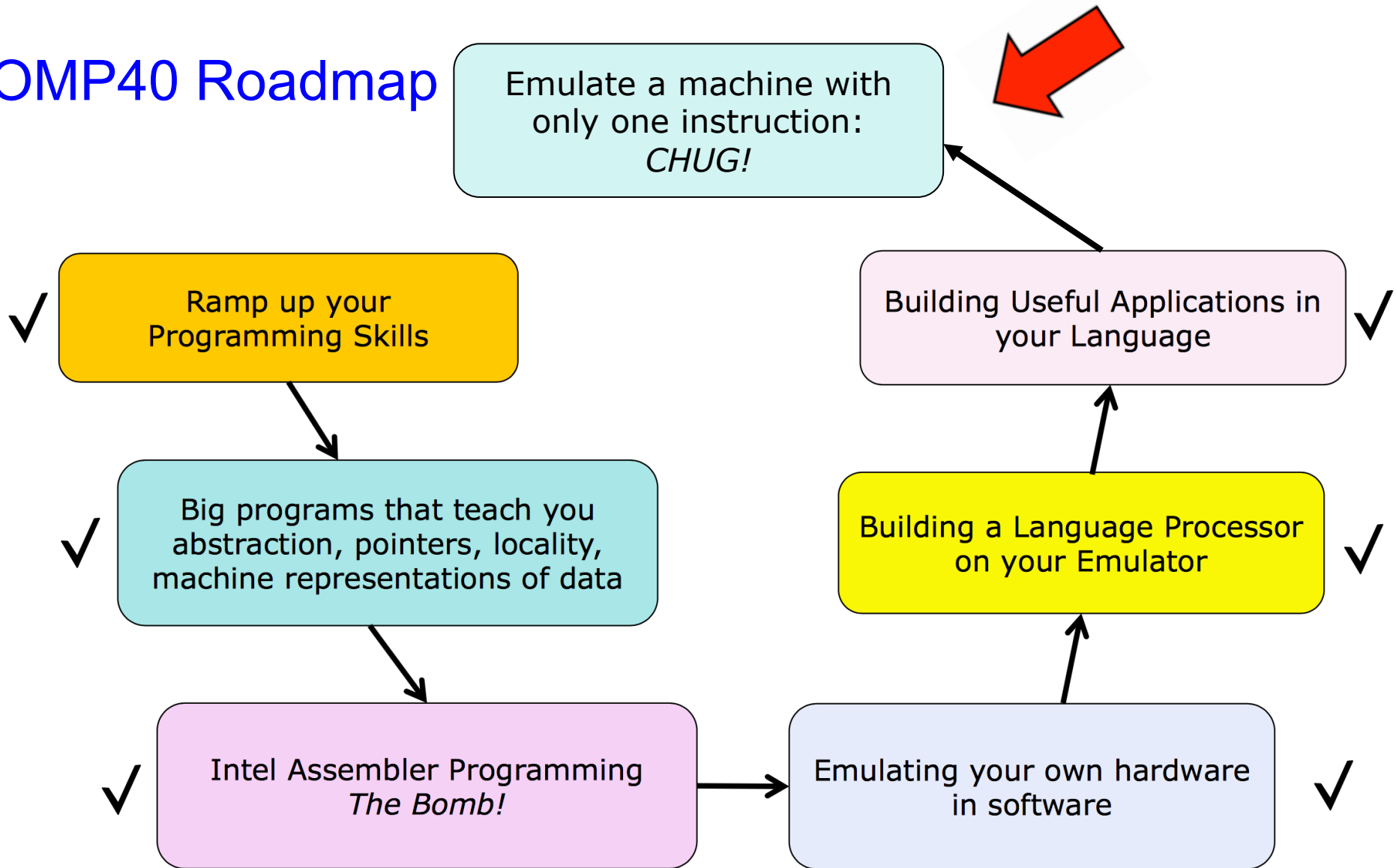


COMP 40: Machine Structure  
And  
Assembly Language Programming (Spring 2017)

# 40sfor40: A Malt Liquor Machine

# COMP40 Roadmap



# 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

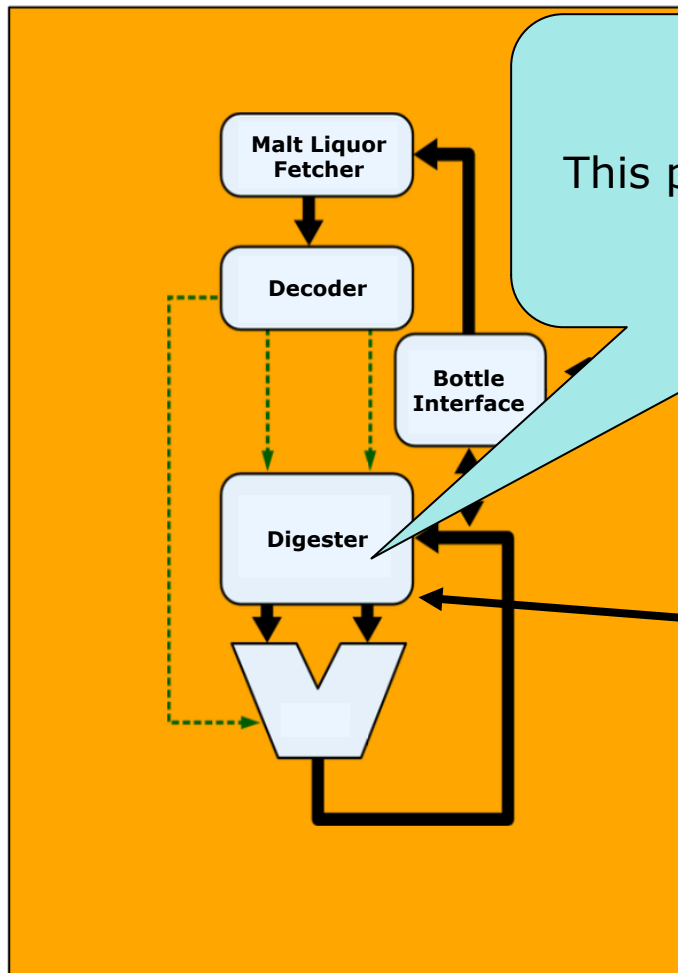
- **Your design document:**

- *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):**

- 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



Memory



# 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*!