Recap of Last Class

- Characteristics of embedded systems
  - Real-time, low power, performance constraints
- Why use a microprocessor
  - Alternatives: ASIC, microprocessor, FPGA
  - Microprocessor: reprogramability, performance/power ratio

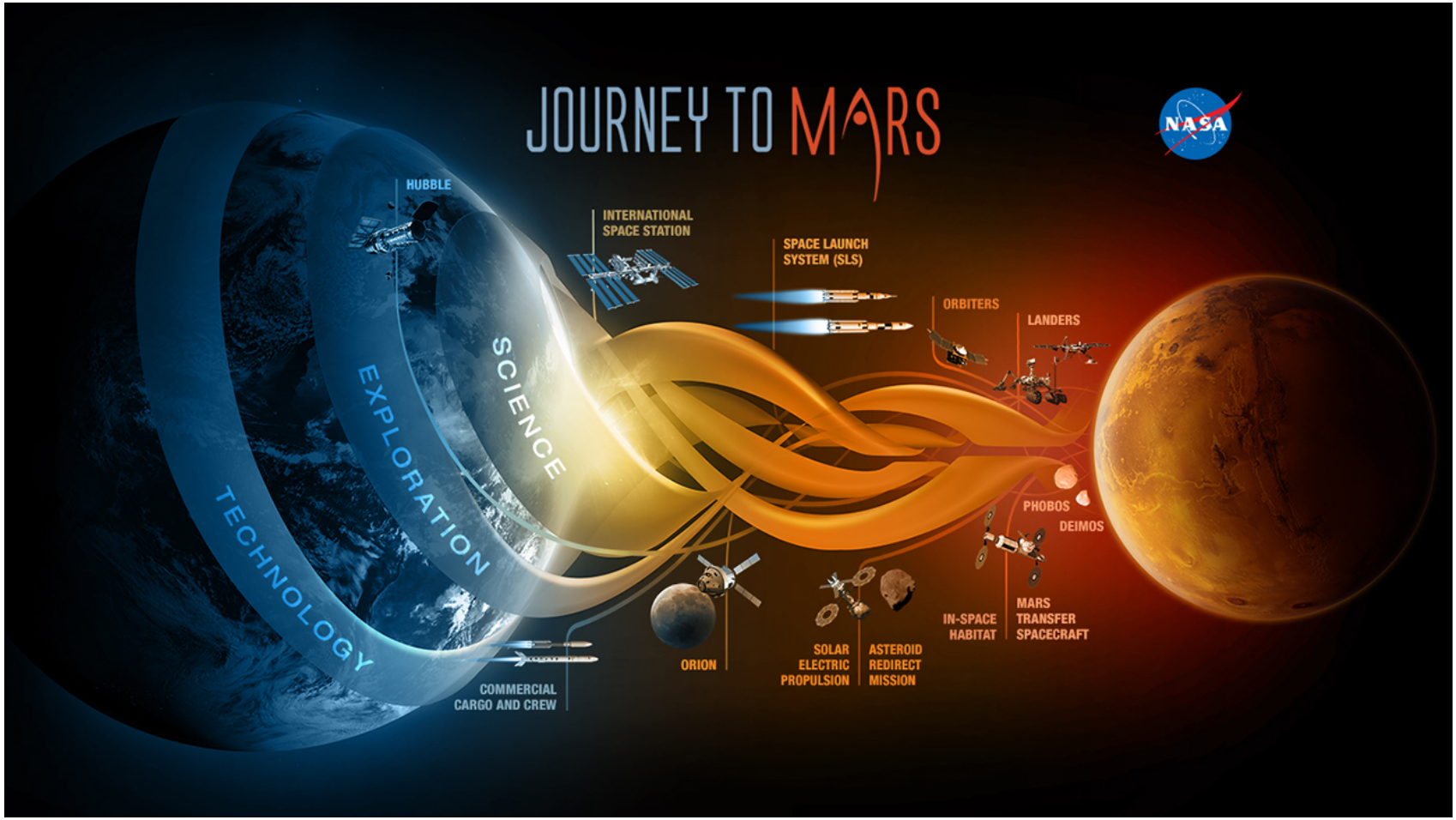
ECE 175
Embedded Systems Design

Design Methodology II

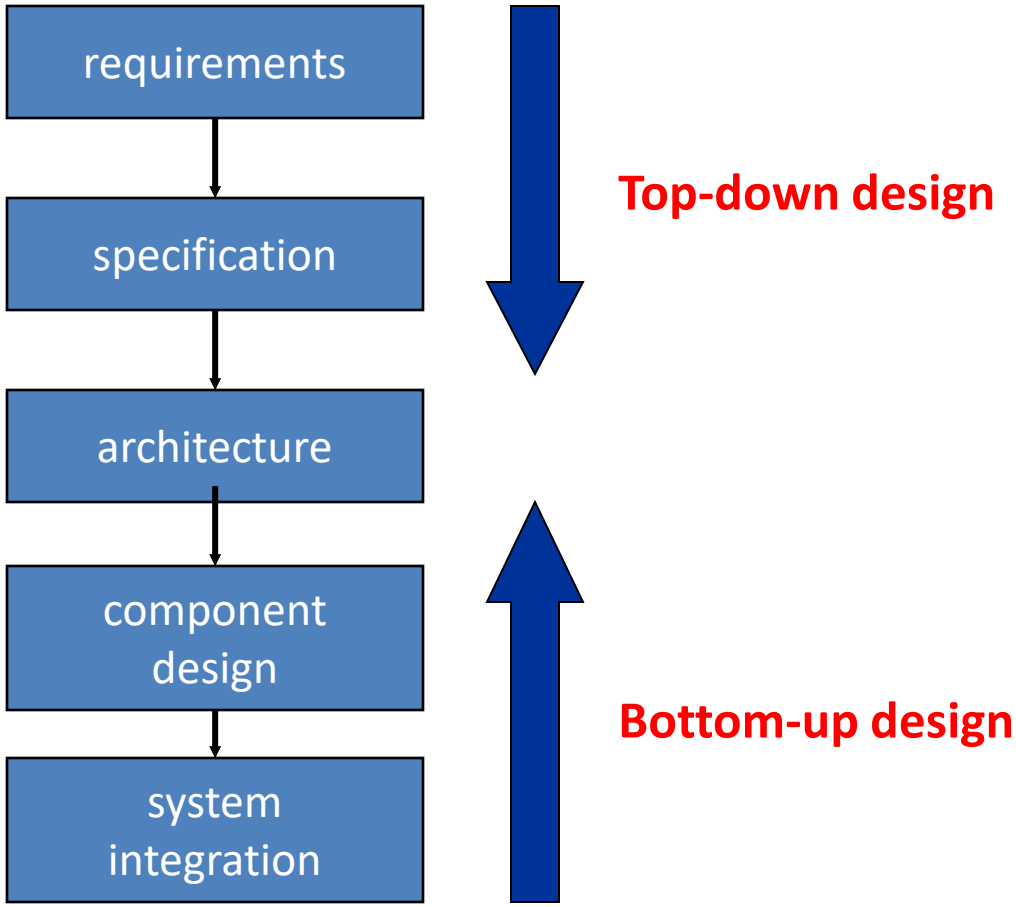
Wei Gao

How to fly to Mars?

- NASA's journey to Mars



Design Methodologies



Requirements

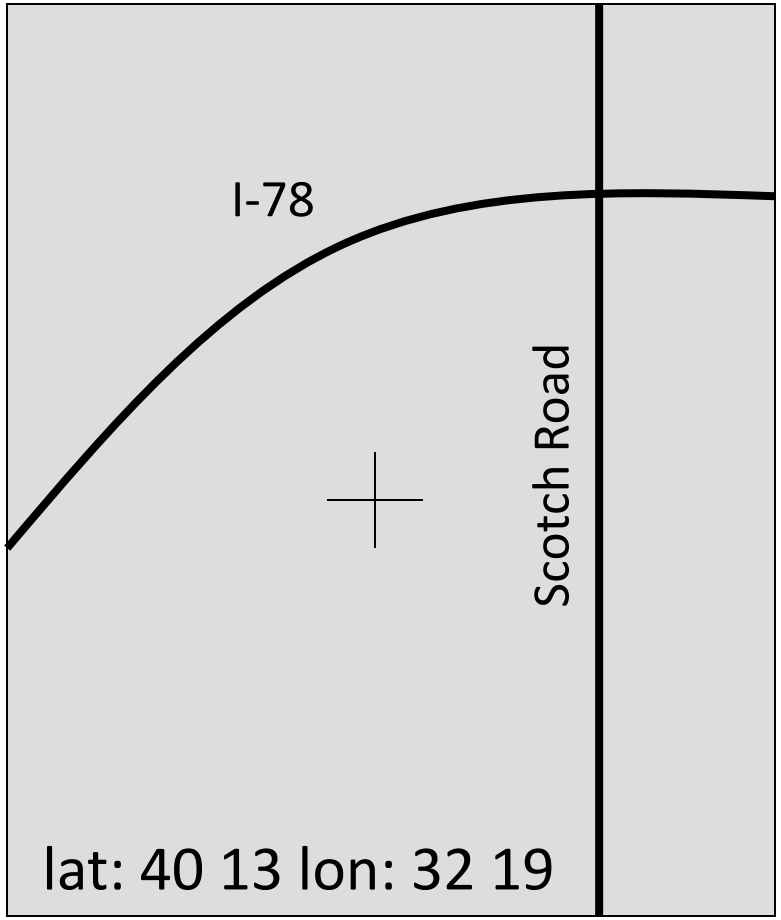
- Plain language description of what the user wants and expects to get.
- May be developed in several ways:
  - Talking directly to customers;
  - Providing prototypes to users for comment.
- Functional vs. non-functional requirements
  - Functional: output as a function of input
  - Non-functional: timing constraints, power consumption, size, weight, etc.

Requirements Form

name
purpose
inputs
outputs
functions
performance
manufacturing cost
power
physical size/weight

Example: GPS Moving Map Requirements

- Purpose: Obtains position from GPS, paints map from local database.



GPS Moving Map Requirements

- Functionality
  - For car driving use, not for airplanes or boats
  - Show major roads and landmarks.
- User interface
  - At least 400 x 600 pixel screen.
  - Three buttons max.
  - Pop-up menu.
- Performance
  - No more than 1 sec power-up.
  - Lock onto GPS within 15 seconds.
  - Update location every 0.25 sec.

GPS Moving Map Requirements

- Cost: street price no more than $100
- Physical size/weight: Should fit in hand.
- Power consumption: Should run for at least 8 hours on four AA batteries.

GPS Map Requirements From

name	GPS moving map
purpose	consumer-grade moving map for driving
inputs	power button, two control buttons
outputs	back-lit LCD 400 X 600
functions	5-receiver GPS; three resolutions; displays current lat/lon
performance	updates screen within 0.25 sec of movement
manufacturing cost	$100 cost-of-goods-sold
power	100 mW
physical size/weight	no more than 2: X 6:, 12 oz.

Specification

- More precise description of the system:
  - should not imply a particular architecture;
  - provides input to the architecture design process.
- May include functional and non-functional elements.
- UML: Unified Modeling Language
  - Not required in this course

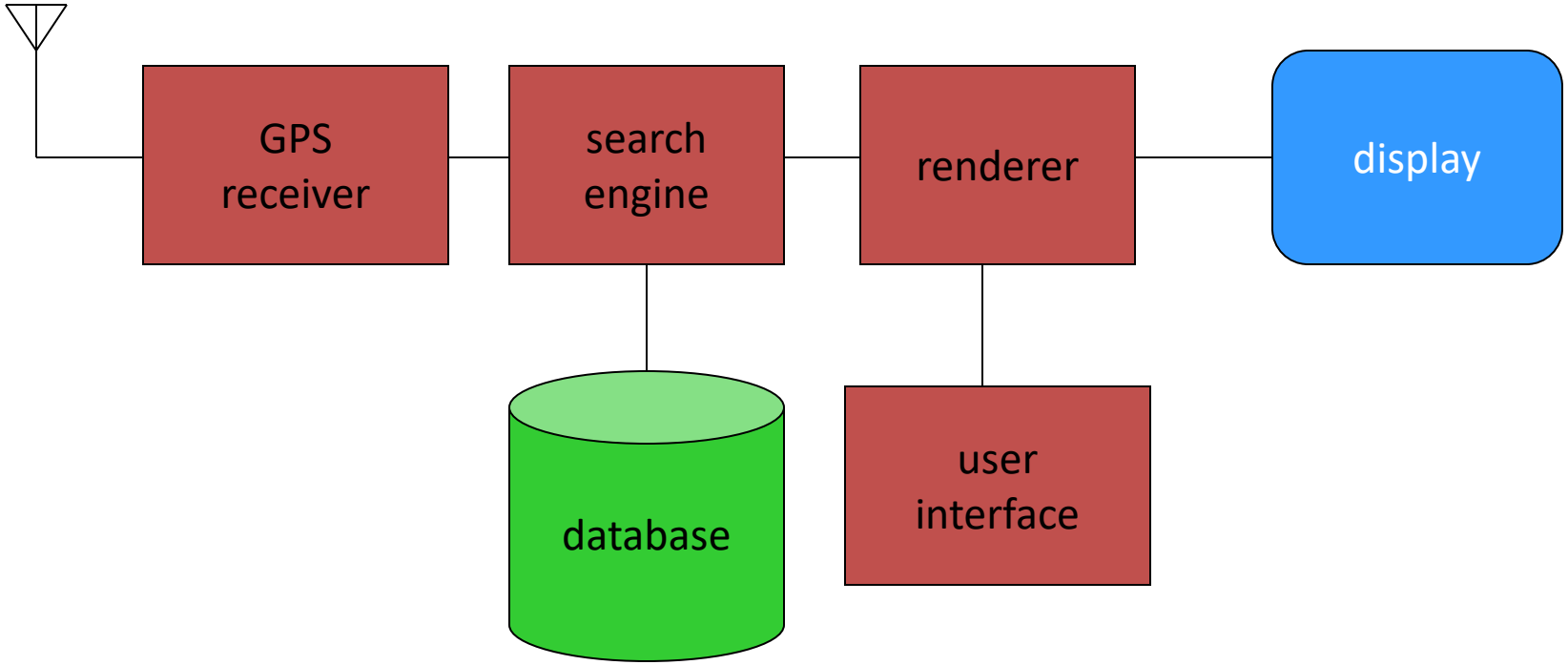
GPS Specification

- Should include:
  - what is received from GPS;
  - map data, format;
  - user interface, menu items;
  - operations required to satisfy user requests;
  - background operations needed to keep the system running
    - Event-driven or periodic?.

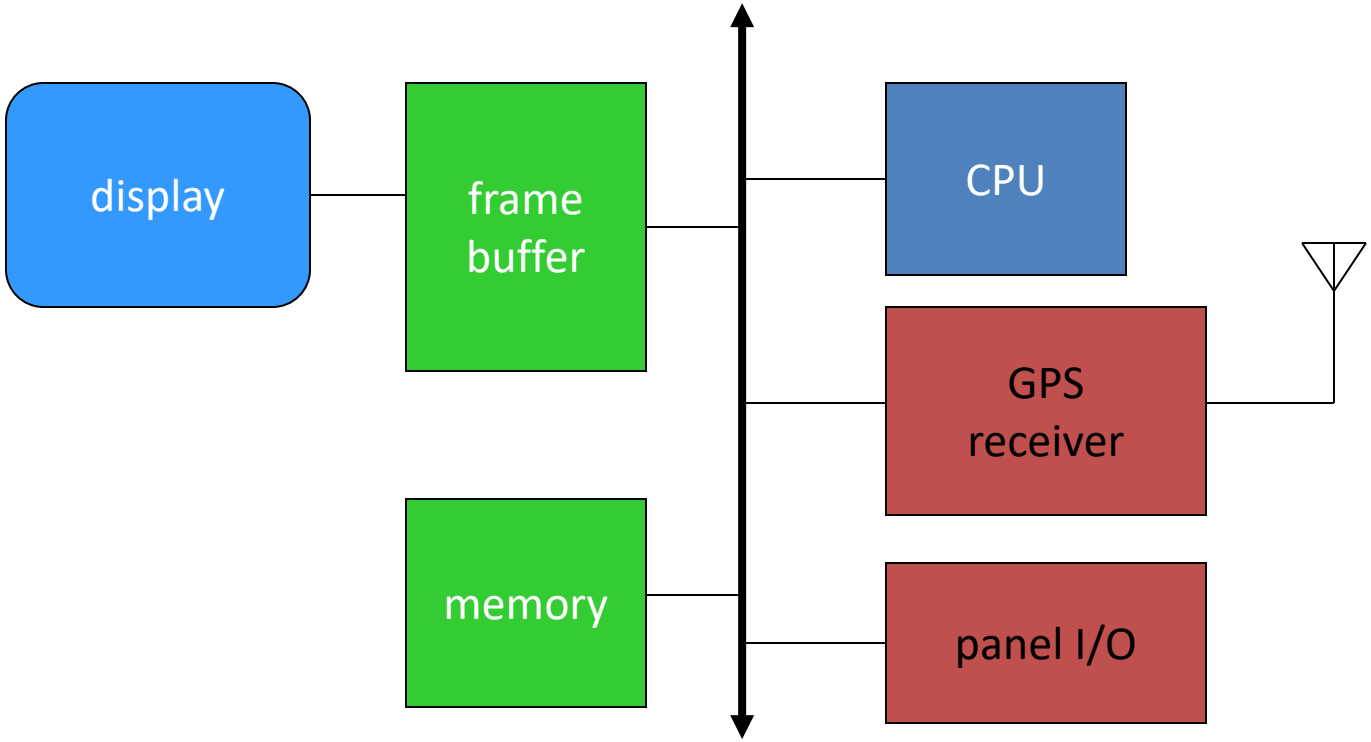
Architecture Design

- What major components can satisfy the specifications?
- Hardware components:
  - CPUs, memory, GPS receiver, etc.
- Software components:
  - Topographical database, access functions, etc.
- Must take into account functional and non-functional specifications.

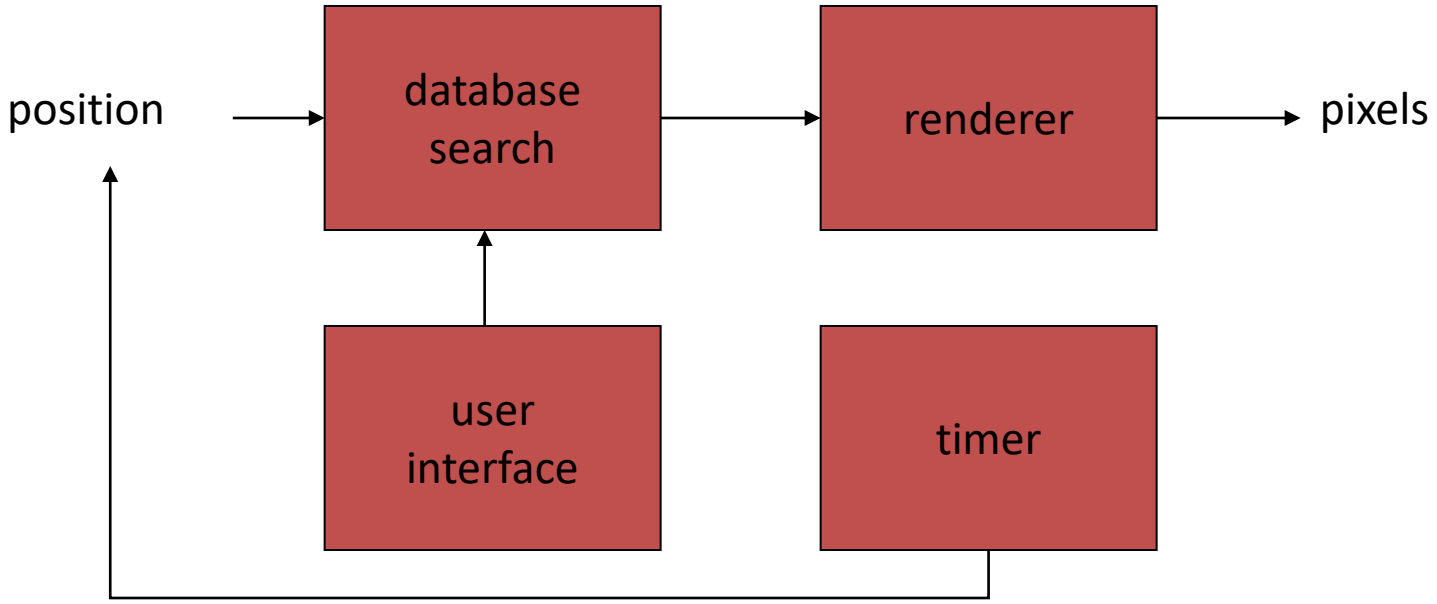
GPS Moving Map Block Diagram



GPS Moving Map Hardware Architecture



GPS Moving Map Software Architecture



Designing Hardware and Software Components

- Must spend time architecting the system before you start coding.
- Components maybe
  - ready-made
  - modified from existing designs
  - designed from scratch
- Components in an embedded system will be covered in following classes

System Integration

- Put together the components.
  - Many bugs appear only at this stage.
  - Individual components should be tested first!

Summary

- Characteristics of embedded systems
  - Non-functional requirements: real-time, low-power, low-cost
- Why do we use microprocessors today?
- Embedded systems pose many design challenges:
  - Design time
  - Deadlines
  - Power
  - Cost
  - …
- Design methodologies help us manage the design process.
  - Top-down vs. bottom-up

Homework Assignment 1

- On design methodology
- 3% of your final grade
  - Individual work, no collaboration is allowed
- One-week turnaround time
  - Due on 9/14 before class
  - Email your work to the TA