EECS 1012: Introduction to Computer Science

November 18, 2016

Writing complex programs

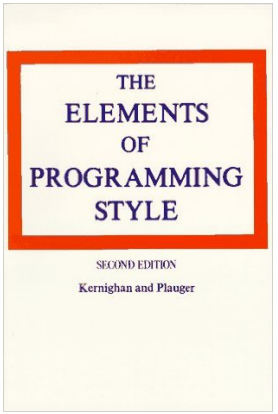
- Need to know the language
- Need to know the tools required to develop program in the language
- Need to know how to structure programs so that they can be developed, tested,documented and maintained.

JavaScript

- Is an incredibly complex and subtle language.
  - When writing a program, do you know the language well enough to exploit all of its features?
  - Do you think the person maintaining the code after you will be equally as talented?
  - If you have to maintain the software, are the subtle language features you manipulated going to be easily understood by you, later?

Style

- Learn from others
- Stand on the shoulders of giants



```
function foo1()
{
  return {
      bar: "hello"
  };
}

function foo2()
{
  return
  {
      bar: "hello"
  };
}
```

Are these functions the same?

Why or why not?

Software design

- Goal is the development of software solutions to problems.
- Always better to **think** about a problem, and how to solve it, rather than just hacking away at the problem.
- One issue with software problems in early stages of teaching computer programming is that the solutions are often so small that you can get away with just hacking at the problem.
  - This approach fails with larger more sophisticated tasks.

So lets take a problem

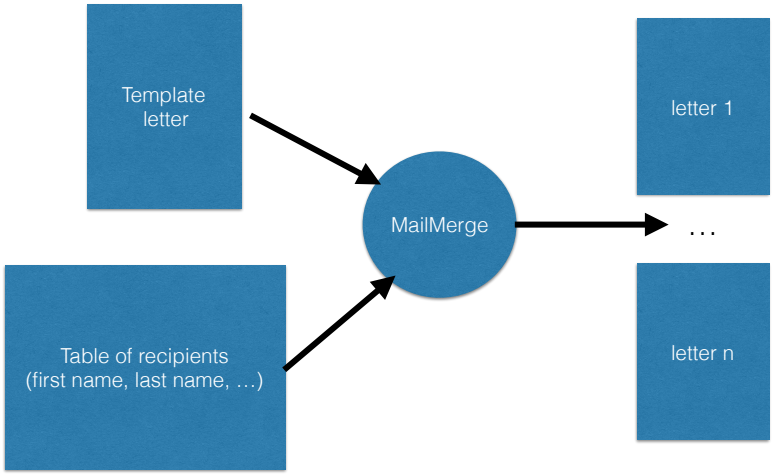
- Problem of generating form letters.
- Happens a great deal
  - MailMerge — originally a program from the 1980s — now a term used to describe the basic process
- Typically have a database of information and a letter template with terms (expressions) that are to be customized based on the database.

Requirements

- What does the system have to do?
  - Allow an organization to create customized letters/memos/text generally based on some representation of the customer's clients

Often the user does not know
(our current mechanism is broken, we don't know why, but make it better)

So, the basic design



What are the requirements?

- Need some way to represent the mail list
  - Microsoft used excel for this
- Need some way to represent the template letter
  - Microsoft used word for this
- Need to be able to distinguish tokens that are to be replaced with those that should not
- Need to have some way to process the template and recipient list to make the individualized letters.

More requirements

- What is a template?
- What are valid replacements?
- How fast?
- Where?
- Roman character set only? Others?

Design

- What is the overall system architecture?
- Where do things come from, where do they go to?
- Who is responsible for what?
- Who will be using the software? What skills do they have?

Implementation

- How can we make this work in <insert language> running under <insert OS> given the <insert networking infrastructure> that the user uses/ wants/needs?

So, given the material taught in this course…

- Represent the template as an HTML file with CSS for styling
  - Seems workable - allows for great customization of the letters
- HTML provides straightforward way to identify tokens to be replaced
  - use the default </ span> pattern

```
<html>
<head>
<script src="q1.js" type="text/javascript"> </script>
</head>
<body>
Dear <span id="salutation">Name</span>;
<p>
It has come to our attention that your invoice <span id="invoice">ID</span>
has yet to be paid. It has now been <span id="time">some time</span> since
you received <span id="item">the material</span> from Evil Incorporated. Please
remit payment immediately. <span id="threaten"></span>
</p>
Yours sincerely,<br>
<br>
<br>
J. Smith, Accounting

<div id="buttons">
<center>
<button onclick="generate()">Next</button>
<button onclick="printit()">Print</button>
</center>
</div>
</body>

</html>
```

Recipients?

- Lots of ways….but, lets think about how we can do this with the least amount of work while providing the most flexibility to the user.
- Use a SQL database of the information
- User can select records based on some set of criteria

What problems are there if we follow this approach?

Possible issues

- How do we print the page once its generated?
  - window.print() - prints the current page
- We can easily change one token in the template, how do we find the full collection of tokens in the template?
  - SQL provides a query that gets all of the column names -> could use that
  - Could make the user specify them manually
  - Others

More issues…

- What if a key appears more than once in the document?
  - Can't use id="key" because its only allowed once -> so lets use class instead, will work just as well

```
<html>
<head>
<script src="q1.js" type="text/javascript"> </script>
</head>
<body>
Dear <span class="salutation">Name</span>;
<p>
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Software development

- Can imagine a few 'modules' in the code
  - Something to process one letter
  - Something to process the database
    - Open connection
    - Get matching records
    - Process records one at a time

Software development

- Can write/test/debug each module separately
- Can **test** each of these **units** individually
  - Call this approach **unit testing**
- An individual **test harness** will be required to test each of these individual units, but this will enable each unit to be written and verified by separate programming groups (teams).

The interface

- Critical to have the two teams agree on the interaction between the two software modules
- Need a **contract** (specification of the duties and responsibilities and interfaces) between these two software modules
  - **Design by contract**

System testing

- Need to verify the entire system works
  - Otherwise the customer will not be very happy at all
- Many classic failures here
  - There are many ways to be famous …. being famous because you, or your software team got it wrong is probably not the best way.

Ariane 5 - software failure

Ariane 5

- Failure in the software system — specifically how to represent numbers on the rocket — resulted in failure
- Total estimated cost of failure
  - 10 years of development
  - $7B $US

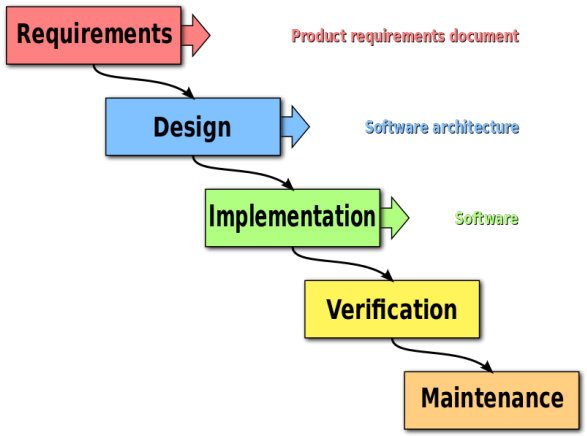
So test..

- And then deploy to the customer.
- Almost immediately the customer will want something else
  - e.g., today's date, pictures, …
- So updates and maintenance

Unit Testing

- Given a formal definition of some module, we can test its performance against the definition.
  - Unit Testing
- Most modern IDE's provide automatic unit testing capabilities
  - Every time you modify the code, you can have it validated against a collection of standard tests.

Waterfall model



Not the only software development model

- e.g., extreme programming

Summary

- Software design is more than just hacking until it works.
  - This will become more and more obvious as you build larger and more complex software within larger teams.
- Exists a large body of knowledge on how best to design and implement software substantive coverage of this in later courses.