Publishing Source Code
for
Reuse and Maintenance

https://JimFawcett.github.io/Resources/PublishingSourceCode.pdf

Jim Fawcett

11 October 2019

Publishing Code Topics

- Software Salvage and Reuse
- Publishing Code Components
- Repository Structure
- Quality Control
- Experiments
- Conclusions

Alternate View – briefer and denser - Site Story from StoryTeller:
https://JimFawcett.github.io/StoryTeller.html

Software Salvage and Reuse

- Software Components
  - Software package that has a single purpose, few dependencies, and is useful for building software systems – example: blocking queue
- Salvage (good)
  - Use existing components with minor modifications
  - That creates new components that must be configured and managed
- Reuse (better)
  - Reuse existing components with **no modification**
  - Use by composing, use as template argument, or use as base for derived classes
- Purpose
  - Improve productivity by building fewer lines of code
  - Avoid introducing new defects and performance issues

Software Reuse – Good news and bad news

- Reusing code from compiler libraries has been spectacularly successful
  - Each language defines a set of libraries that support building projects
  - Updated with each new standardization of the language.
- Software reuse in the academic, industrial, and commercial domains has often been disappointing
  - Typical use is:
    - Grab the last relevant project(s)
    - Attempt to throw away unneeded parts
      - Sometimes we keep unneeded parts because too much breaks if we remove
      - That causes maintenance problems
    - Merge and add needed new parts
    - Spend a lot of time fixing breakage

Application Domain Targets – Candidates for Support?

- Academic Research: 5 – 10 code developers
  - Code life-time: 3 – 5 years
  - Example: Natural Language Processing (NLP)
- Open Source Development: 5 – 1000 active developers, many casual contributors
  - Code life-time: 10 - 20 years
  - Example: Linux
- Industrial Development: 5 – 10 developers
  - Code life-time: 5 – 20 years
  - Example: Machine Tool Control
- Commercial Products: 10 – 30 developers
  - Code life-time: 20 – 30 years
  - Example: Microsoft Word
- Aerospace Programs: 5 – 200 developers
  - Code life-time: 20 – 30 years
  - Example: Submarine control, Area surveillance, ..

Supporting Software Reuse

- Purpose: to provide for application domain specific code the same advantages attained from compiler libraries
- For reuse a software component should be designed so that reusing in a new project is quicker and easier than creating from scratch
  - There are many good examples, e.g., the C++ Standard Template Library and Apache HttpComponents.
  - How to do that is a topic for another story.
- Components must be available
  - That implies some cloud-based repository
- Components need to be documented
  - Concept, use statement, use examples, design, status

Website Story Prologue

- This is a presentation of goals and features of a website designed to publish source code in support of software reuse.
  - https://JimFawcett.github.io  Take a quick tour
- The site is a second-generation facility based on experience with an academic website:
  - https://ecs.syr.edu/faculty/fawcett/handouts/Webpages/fawcettHome.htm
- I used that site for graduate software design courses taught at Syracuse University for many years.
  - Published lecture content
  - Provided access to code components students used for class projects

Publishing Code Components for (Re)use

- The goal of this site is to improve that first site's process by publishing code in an effective way
- Publishing some code artifact is the act of making it available, in usable form.
- Five main facets of publication:
  - Containment
  - Delivery
  - Location
  - Interpretation
  - Quality Control

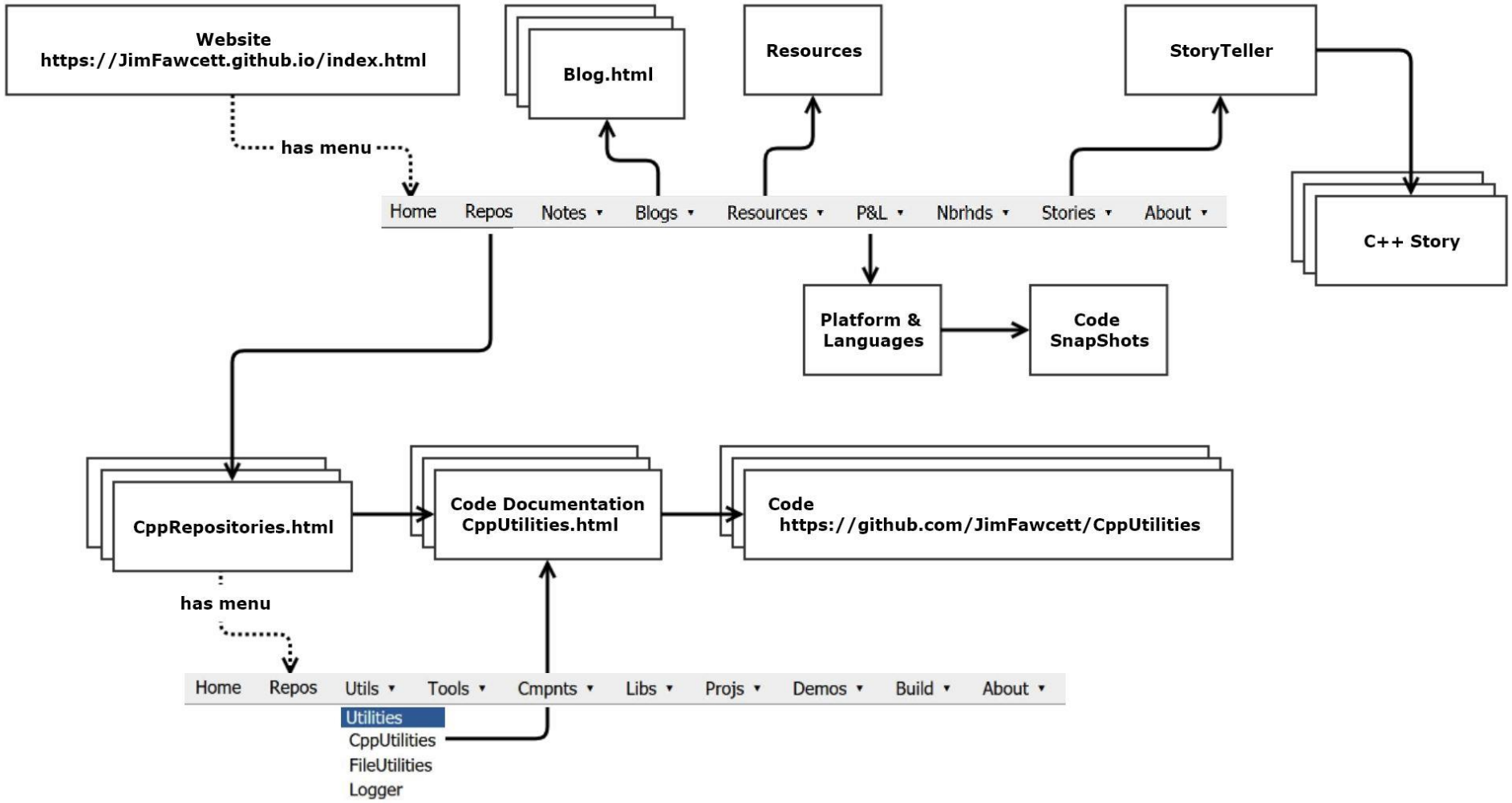
The Issues

- Source code containment and delivery are solved problems
  - Cloud-based facilities like github do that very well
- The issues are finding and understanding code relevant to a need
  - We want most code repositories to be large – to support broad reuse
  - How do we find, in a large repository, code that fills some need?
- A good option - website documentation, colocated with source code
  - To support both salvage and reuse, documentation needs to provide information about the component's concept, design, and typical use

Website for Publishing Reusable Components

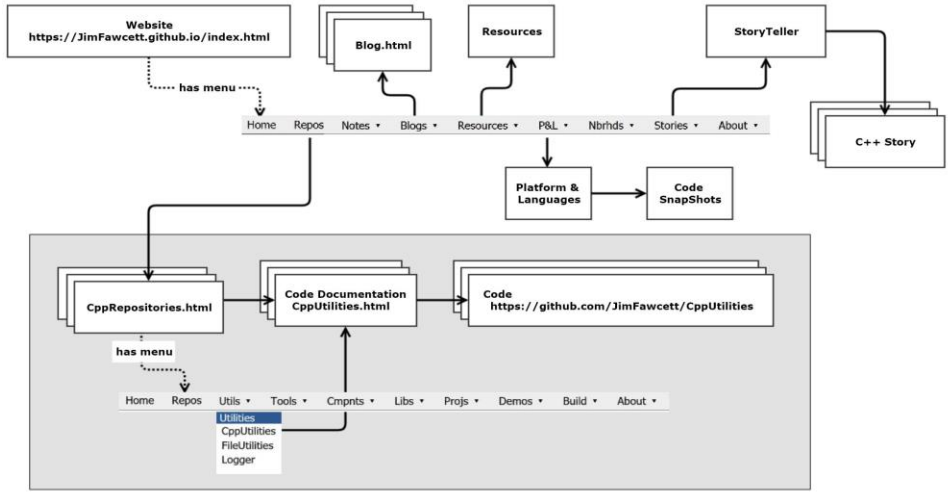
- A site for publishing source code will need:
  - A structure for holding organized collections of code
  - An intuitive navigation process to find specific code and resources
  - Documentation for each component
    - Concept, Design, Usage, Status
  - Additional resources to help users understand relevant technologies
    - Language and platform references
    - Brief code snapshots with commentary, provided as webpages
    - Related blogs and opinion pieces
    - Code standards
  - Stories and Videos
    - Discussions, each focused on a single theme

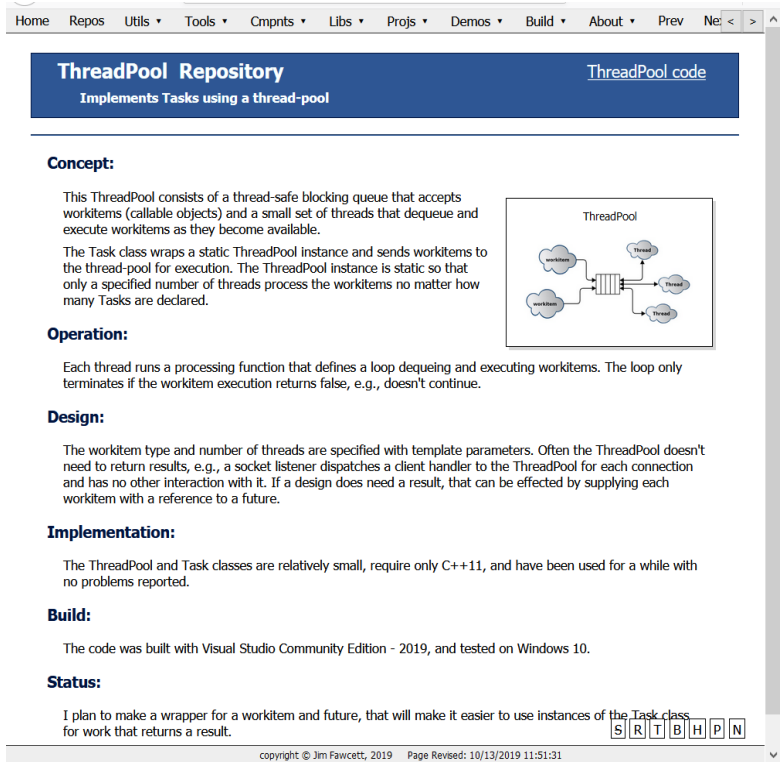
Site Structure – https://JimFawcett.github.io



Site Structure - Code Repos

https://JimFawcett.github.io/Repositories.html

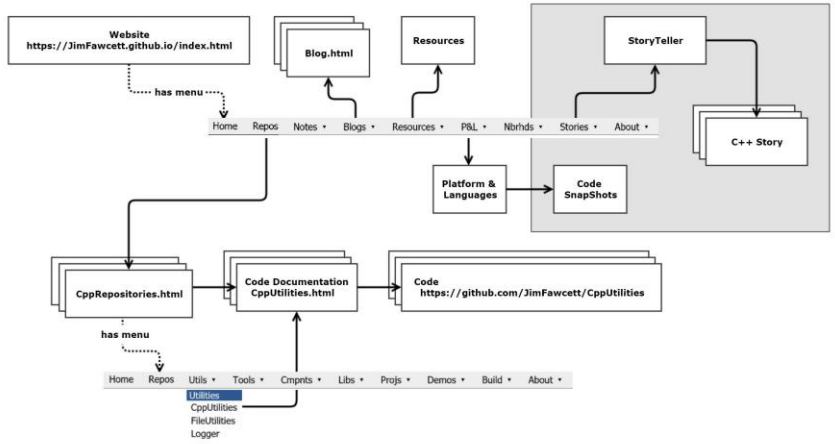


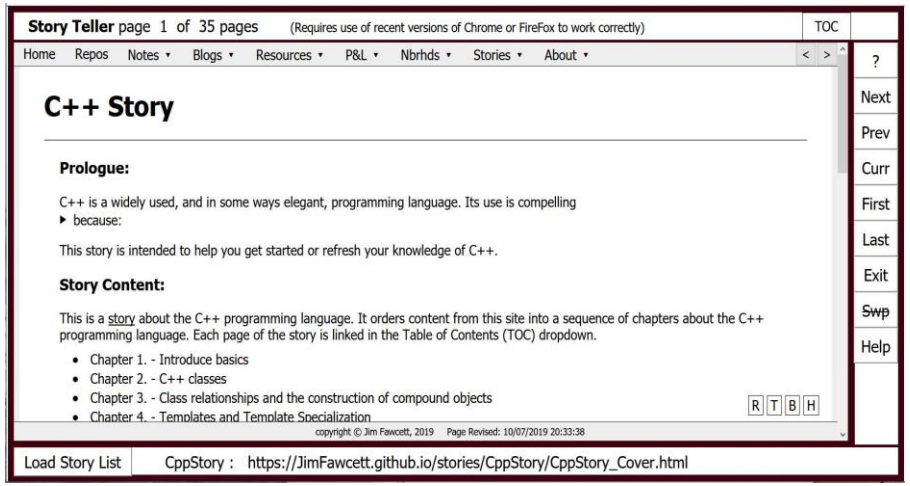


- Code Repositories are the most important part
- Goal is to have large collections to promote broad reuse
- Navigation is an issue. Solution:
  - Link from Home menu
  - Factor into (language or product specific) collections
  - Factor each collection into individual repositories (utilities, tools, …)
  - Link first to documentation which then links to code folder

Site Structure – Stories

https://JimFawcett.github.io/StoryTeller.html



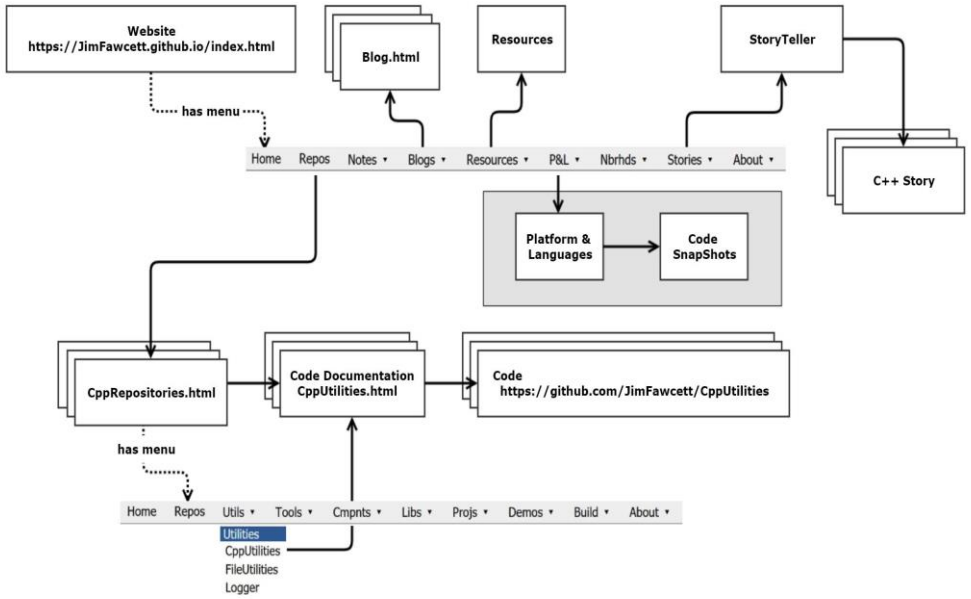


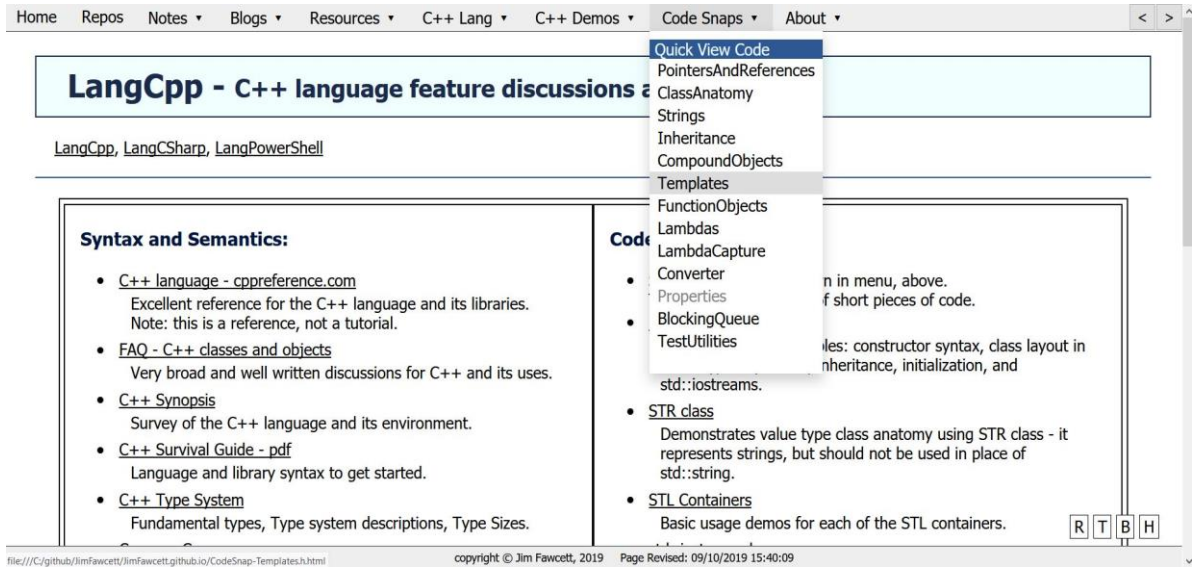
- Stories are organized collections of pages from the site that all focus on a single theme
- Intent is to help users grapple with site content
- Examples are:
  - C++ story – tutorial material
  - SiteStory – description of this site
  - MLiPS – guest story about ML
- Image to the left is StoryTeller interface

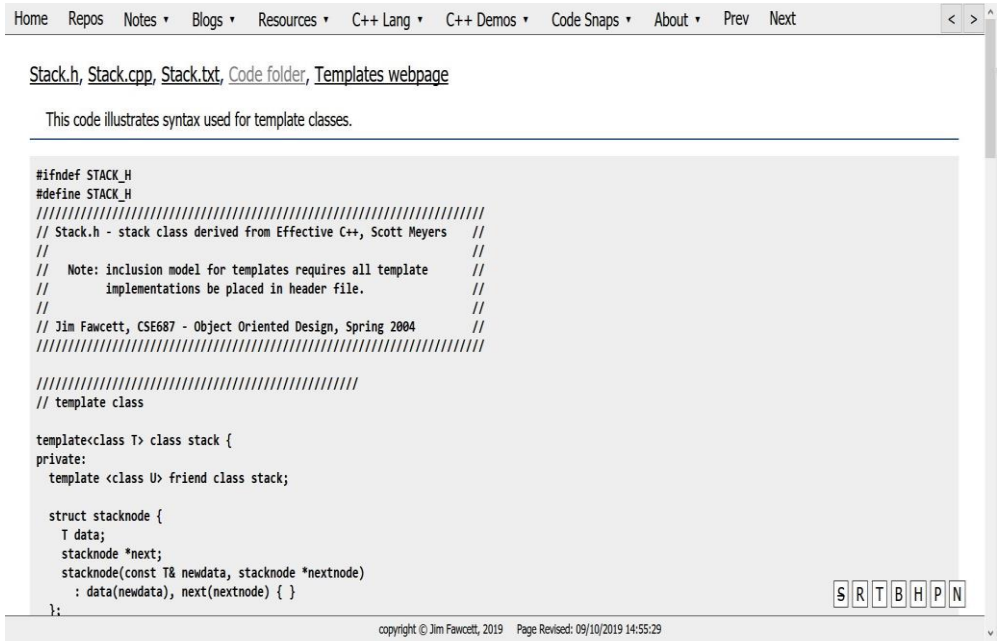
Site Structure – Code Snaps

https://JimFawcett.github.io/LangCpp.html

- CodeSnaps
  - Source code converted to HTML page
  - Provides quick access to views of important code fragments
  - No need to download from repository to explore







Quality Control

- Without quality control it's easy for repositories to become a sea of flotsam[1] and jetsam[2]
  - Some good content, but a lot of content that isn't ready for reuse
- To avoid that destination two things are necessary:
  - An effective structure for disclosing the contents of a repository
    - This site provides a candidate
  - Willingness of the site sponsor to invest in review and improvement
    - Standards – brief statements - components must meet to become candidates
    - Knowledgeable and productive person(s) to evaluate a component against the standards and admit or reject
    - Continuing background review activity – is this component still valuable?
- Note that github provides tools to help, e.g., wikis, charts, …

---

[1] Flotsam - cargo that surfaces from a sunken ship

[2] Jetsam – cargo that is intentionally cast from a ship in distress.

Experiments

https://JimFawcett.github.io/Tests.html - Main menu > Resources > UI Widget Tests
https://JimFawcett.github.io/SiteStory_4.html - Main menu > stories > SiteStory

- Experiments to make the site's publishing process more effective are continuing:
  - Developing UI widgets to use webpage real estate effectively
    - User driven diagram resizer
    - Slide-in panels
    - Slide show
    - Code blocks for presentation
    - Photo styling
  - Navigation schemes
    - Dropdown menus
    - Page sequences (defined by hidden links)
    - Navigation buttons and key presses
  - Continuing to think about site organization schemes

Status and Conclusions

- Status - https://JimFawcett.github.io:
  - Most of the structure described is in place
  - More than 40 repositories of mostly C++ code are published
  - Several stories are published
  - Other resources and CodeSnaps are available from the site
- Plans
  - Install more code repositories
  - Install starter site
  - Start to add videos
- Conclusions:
  - Static sites seem like a good tool for publishing
    - Main issue is text or keyword searches not available with static sites
    - Can be addressed with local mirror and tools for synchronizing and local searching
  - Required effort is reasonable for the expected payoff
    - This site went from zero to current status in four months of my time
    - However, I've built a site like this before.

Appendix - Domains

Application Domain Targets – Candidates for Support?

- Academic Research: 5 – 10 code developers
  - Code life-time: 3 – 5 years
  - Example: Natural Language Processing (NLP)
- Open Source Development: 5 – 1000 active developers, many casual contributors
  - Code life-time: 10 - 20 years
  - Example: Linux
- Industrial Development: 5 – 10 developers
  - Code life-time: 5 – 20 years
  - Example: Machine Tool Control
- Commercial Products: 10 – 30 developers
  - Code life-time: 20 – 30 years
  - Example: Microsoft Word
- Aerospace Programs: 5 – 200 developers
  - Code life-time: 20 – 30 years
  - Example: Submarine control, Area surveillance, ..

Open-Source Domain

Parts flow in, a product flows out

- Open-source projects like Linux
  - Locally developed code flows to the cloud
    - Local contributors push to remote development branch
  - A single large system flows from the cloud to local users
    - Download a distro
- Open-source applications like node.js
  - Developed by small group of contributors
  - Users download and install system with additional imports
- Open-source libraries like jQuery.js
  - Developed by small group of contributors
  - Users bind remote library to webpages with Content Delivery Network (CDN) links

- This domain already has a publishing model that has different goals than ours

Other Domains

Components installed, flow out to users

- Users search for a component to fill a current implementation need
  - Repository needs to be large, i.e., hold many components so there is a fairly good change to find something useful
  - So search and interpretation need to be effective
  - For repositories with hundreds of components, that is not trivial
- The main issues are:
  - Developing a useful search process that is intuitive and quick
  - Helping users interpret a found component
    - What does it do?
    - How is it designed?
    - How to integrate with existing code?
- These domains appear to be good candidates for the publication process proposed here

Academic Research Domain

- Academic Research: 5 – 10 code developers
  - Code life-time: 3 – 5 years
  - Example: Natural Language Processing (NLP)
- An academic researcher may have 2 or 3 doctoral candidates working on related parts of a research project.
- She may collaborate with two or three colleagues, perhaps at different universities.
  - Each of those colleagues may have a similar team working on related projects.
- There usually is continuing work on the same or related research projects for many years.
- It is quite common that this work develops software tools for gathering and analyzing data. Sometimes software is part of the end product, e.g., compilers for a new language, an architecture for streaming or classifying content, …
- These software developments are rarely maintained well. Often documentation is nothing but code and the papers that describe research results and mention the software as an aside.
- Our methods are applicable.

Open Source Domain

- Open Source Development: 5 – 1000 active developers, many casual contributors
  - Code life-time: 10 - 20 years
  - Examples: Linux, Node.js, MongoDB
- Following an initial period of development, a project often settles into a maintenance mode:
  - Maintain the same mission and design.
  - Add new features and port to new platforms.
- Occasionally revise most of the code and support new missions.
- Documentation varies from poor to outstanding.
  - Linux documentation is one of the outstanding ones:
    - https://www.kernel.org/doc/html/v4.10/index.html
  - Some projects focus on api level documentation – how to use the code.
  - Some focus on maintenance – what are the parts, how are they related, code standards, …
- Their goal is different than ours – our methods may not apply.

Industrial Development Domain

- Industrial Development: 5 – 10 developers
  - Code life-time: 5 – 20 years
  - Example: Machine Tool Control
- Code base starts with an initial product
- New products start from that initial code
  - Has a common code baseline been defined?
  - Code reviews are held during development
  - At product completion is code reviewed and refactored into reusable parts and product specific code?
  - Is the organization willing to provide overhead effort to evolve the common code base?
- Our methods are applicable. A scaled down version is probably appropriate.

Commercial Domain

- Commercial Products:
  - Code life-time: 20 – 30 years
  - Example: Microsoft Word
- Product may start with code framework, standards, and a specification
  - For Microsoft Office and many other products, the framework has been the Microsoft Component Object Model (COM) – technology was specifically designed for reuse
    - It appears that, moving forward, COM will be hidden with a wrapper technology - Windows RunTime (WinRT): https://en.wikipedia.org/wiki/Windows_Runtime
  - Specification is developed by a Program Manager and reviewed by the development team
- Microsoft has spent a lot of resources on documentation, with mixed results
  - Executing a search in MSDN for WinRT results in 6,180,000 results.
  - That isn't a useful query – in fairness, the results are prioritized
  - It's quite common that when you arrive at a useful documentation page you get partial results with the remainder often linked to many pages scattered over the vast reaches of MSDN
- There are many Microsoft technologies each with its own products, APIs, code examples.
  - Some, like the .Net framework have outstanding organization and documentation.

Aerospace Domain

- Aerospace Programs: 5 – 200 developers
  - Code life-time: 20 – 30 years
  - Example: Submarine control, Area surveillance, ..
- Development is product oriented, starting with an initial contract, and continuing for possibly many years of enhancements and new contracts that build on the existing product technology
- An example is the development of area surveillance radar systems
  - Typical lifetime of a radar system is 20 years
    - The code has to be maintained over that lifetime, sometimes by the manufacturer, sometimes by the customer.
  - Once an initial contract has been successfully completed it is common for many contracts to be awarded for new versions.
    - Usually a large part of a new product is based on an existing one and will share a large fraction of its code
    - In most cases the new contract requires new features and enhancements – the customer looks at the original and decides how to embellish
- The Capability Maturity Model was developed beginning when the Air Force funded a study with the Software Engineering Institute. Its intent is to encourage DoD contractors to develop and maintain a consistent process for creation of software.
  - https://en.wikipedia.org/wiki/Capability_Maturity_Model
  - CMM provides guidelines, but it is a model and a yardstick for assessing capability of contractors
  - It does not provide specifics for tools and techniques that support reuse
- Our methods apply for individual product teams. Unknown how that would scale to corporation level.

That’s all Folks!