Code Archeology

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Learning goals

- Understand and scope the task of taking on and understanding a new and complex piece of existing software.
- Appreciate the importance of configuring an effective IDE.
- Contrast different types of code execution environments including local, remote, application, and libraries.
- Enumerate both static and dynamic strategies for understanding and modifying a new codebase.

Context: big ole pile of code.

…do something to it.

You cannot understand the entire system.

Goal: develop and test a working model or set of working hypotheses about how (some part of) a system works.

- Working model: an understanding of the pieces of the system (components), and the way they interact (connections).
- It is common in practice to consult documentation, experts.
- Prior knowledge/experience is also useful (see: frameworks, architectural patterns, design patterns).
- Today, we focus on individual information gathering via observation, probes, and hypothesis testing.

TWO PROPERTIES OF SOFTWARE THAT ARE USUALLY ANNOYING THAT WE CAN TAKE ADVANTAGE OF.

Software constantly changes → Software is easy to change!

Is this wall load-bearing?

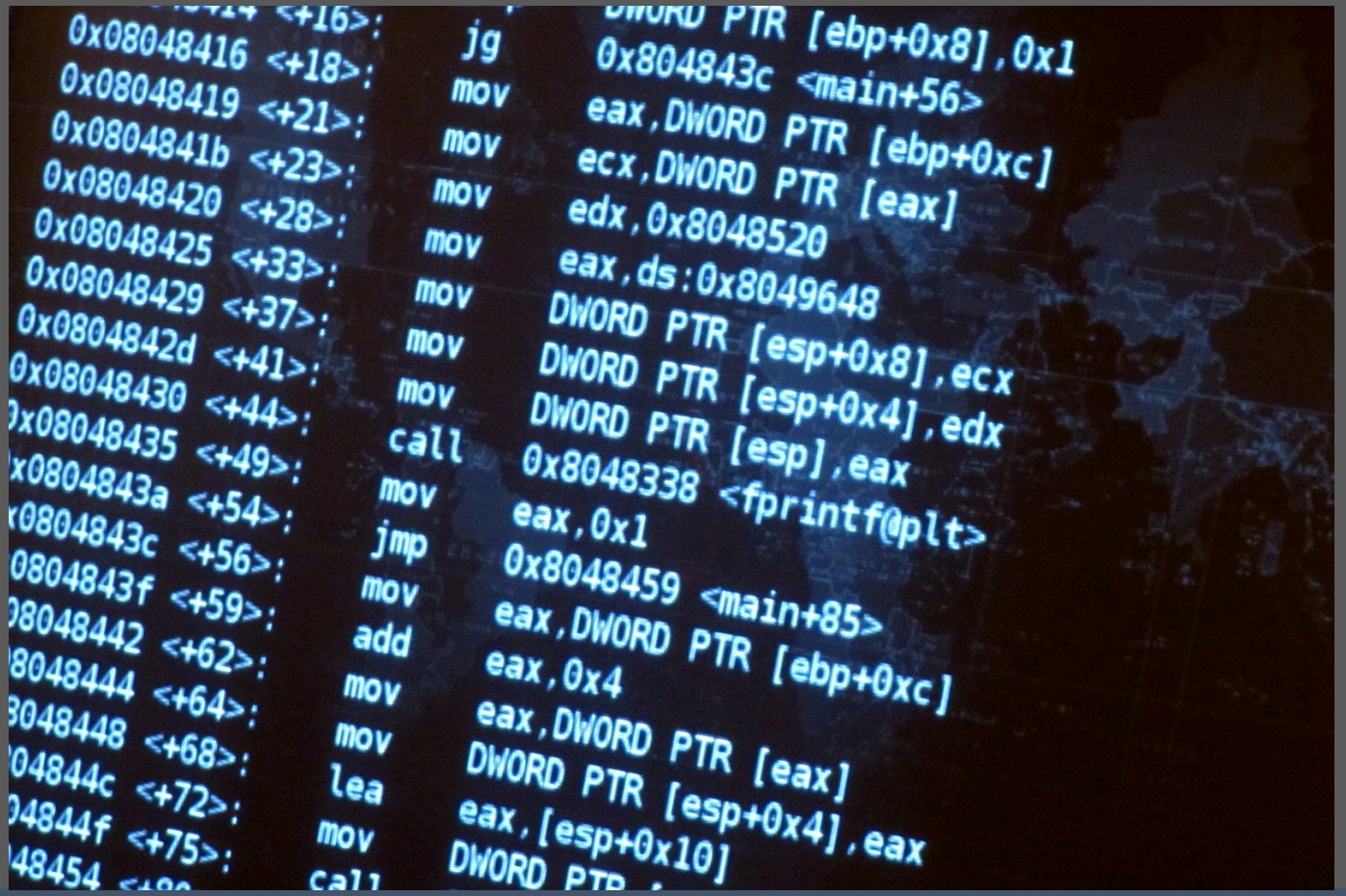
Software is a big redundant mess → there's always something to copy as a starting point!

Key insight in grokking unfamiliar code/apps

CODE MUST RUN TO DO STUFF!!

1. If code must run, it must have a beginning

2. If code must run, it must exist



The Beginning: Entry Points

Some trigger that causes code to run.

- **Locally installed programs**: run cmd, OS launch, I/O events, etc.
- **Local applications in dev**: build + run, test, deploy (e.g. docker)
- **Web apps server-side**: Browser sends HTTP request (GET/POST)
- **Web apps client-side**: Browser runs JavaScript

Code must exist. But where?

Helps to identify what's knowable and what's changeable

- **Locally installed programs**: run cmd, OS launch, I/O events, etc.
  - Binaries (machine code) on your computer
- **Local applications in dev**: build + run, test, deploy (e.g. docker)
  - Source code in repository (+ dependencies)
- **Web apps server-side**: Browser sends HTTP request (GET/POST)
  - Code runs remotely (you can only observe outputs)
- **Web apps client-side**: Browser runs JavaScript
  - Source code is downloaded and run locally (see: browser dev tools!)

Side note on build systems

- Basically the same across languages / platforms
  - Make, maven, gradle, grunt, bazel, etc.
- **Goal**: Source code + dependencies + config → runnables
- Common themes:
  - Dependency management (repositories, versions, etc)
  - Config management (platform-specific features, file/dir names, IP addresses, port numbers, etc)
  - Runnables (start, stop?, test)
  - Almost always have ‘debug’ mode and help (‘-h’ or similar)
  - Almost always have one or more “build” directories (= not part of source repo)

Can running code be **P**robed/**U**nderstood/**E**dited?

Transparent

Source code built locally

(P+U+E)

Translucent

Binaries running locally

Open source	Closed source
(P+U)	(P)

Opaque

Server-side apps running remotely

Open source	Closed source
(U)	-

Source code built locally

CREATING A WORKING MODEL OF UNFAMILIAR CODE

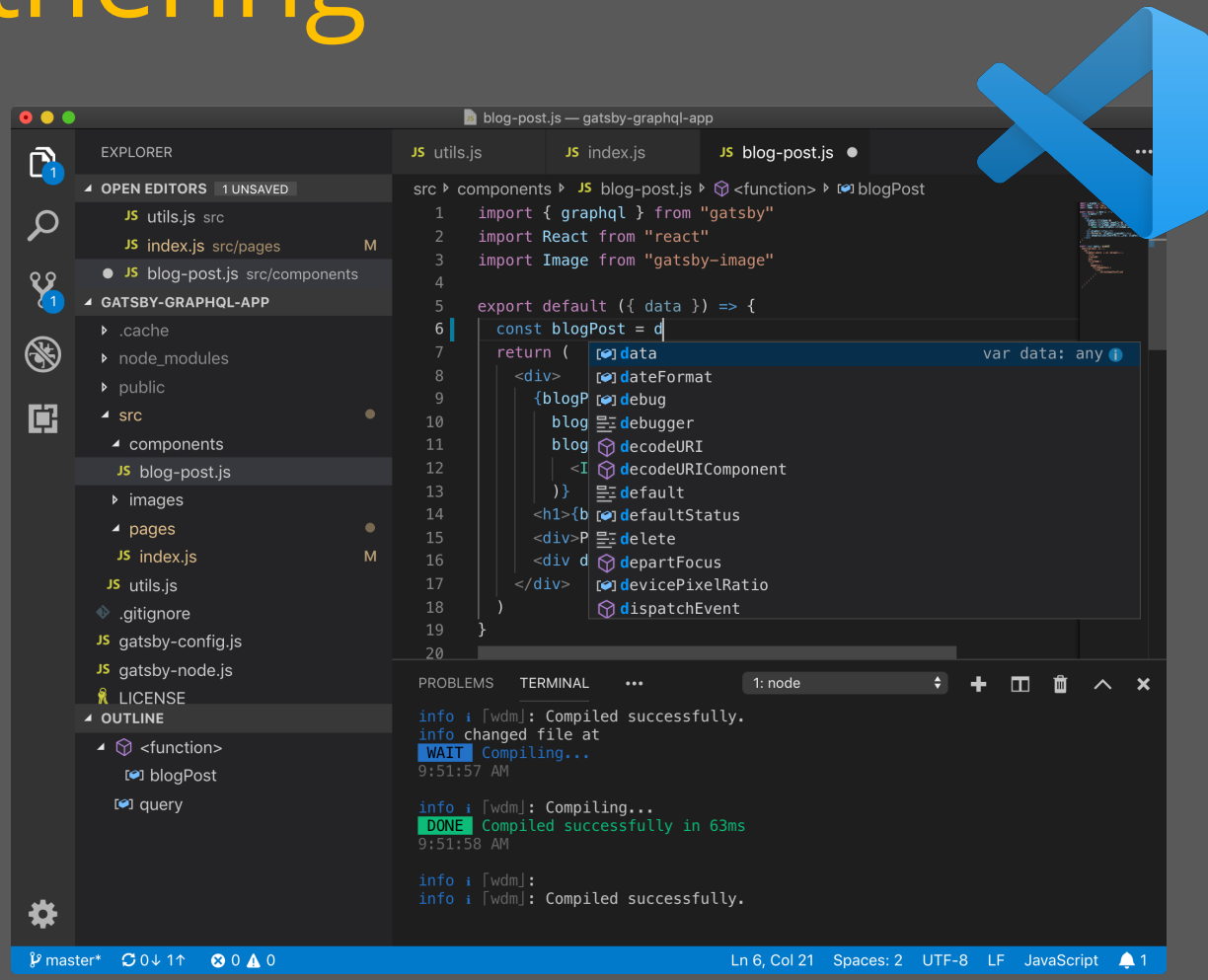
Static (+dynamic) information gathering

- Basic needs:
  - **Code/file search and navigatio**
  - Code editing (probes)
  - Execution of code, tests
  - Observation of output (observation)
- Many choices here on tools! Depends on circumstance.
  - grep/find/etc. Having a command on Unix tools is invaluable
  - A decent IDE
  - Debugger
  - Test frameworks + coverage reports
  - Google (or your favorite web search engine)

At the command line: **grep** and **find**!
(Do a web search for tutorials)

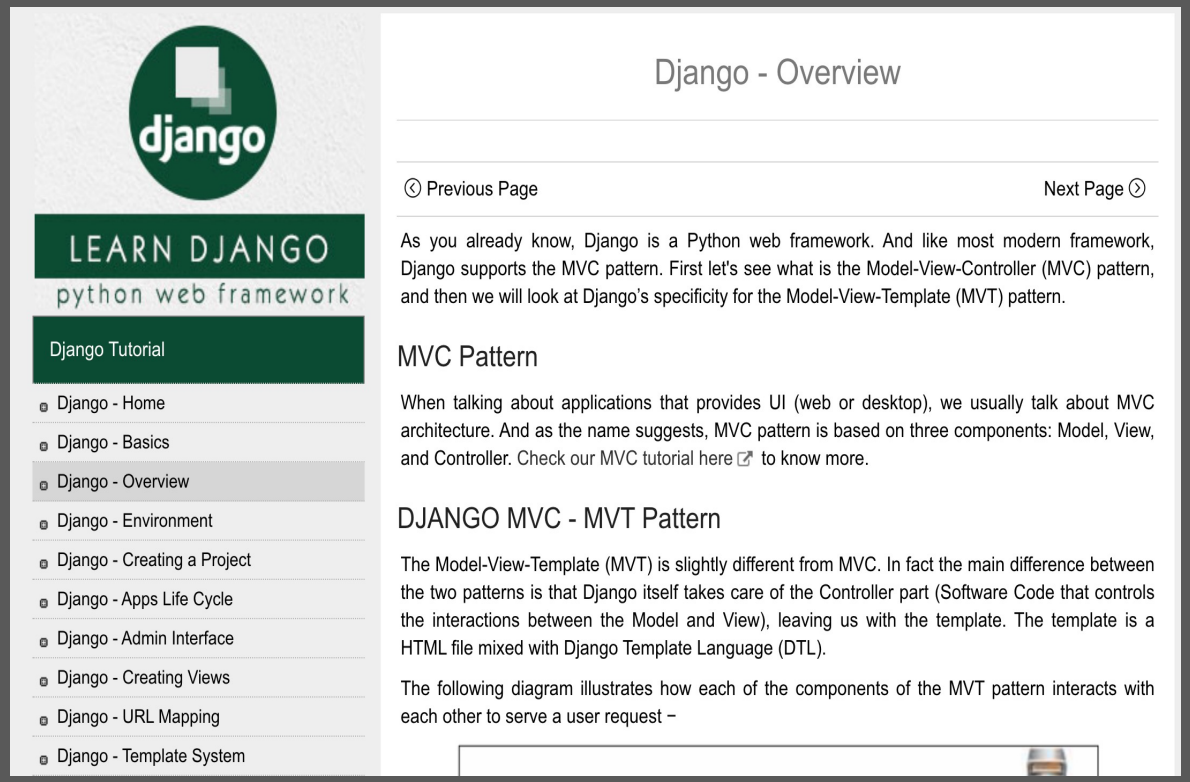
Static Information Gathering

- Please configure and use a *legitimate* IDE.
  - No favorites? We recommend VSCode and IntelliJ IDEA.
- Why?
  - “search all files”
  - “jump to definition”
  - “download dependency source”
- Remember: real software is too complicated to keep in your head.



Consider documentation/tutorials judiciously

- Great for discovering entry points!
- Can teach you about general structure, architecture.
  - Forward-reference to architectural patterns!
- As you gain experience, you will recognize more of these, and you will immediately know something about how the program works.
- For example, next time you work on a webapp…



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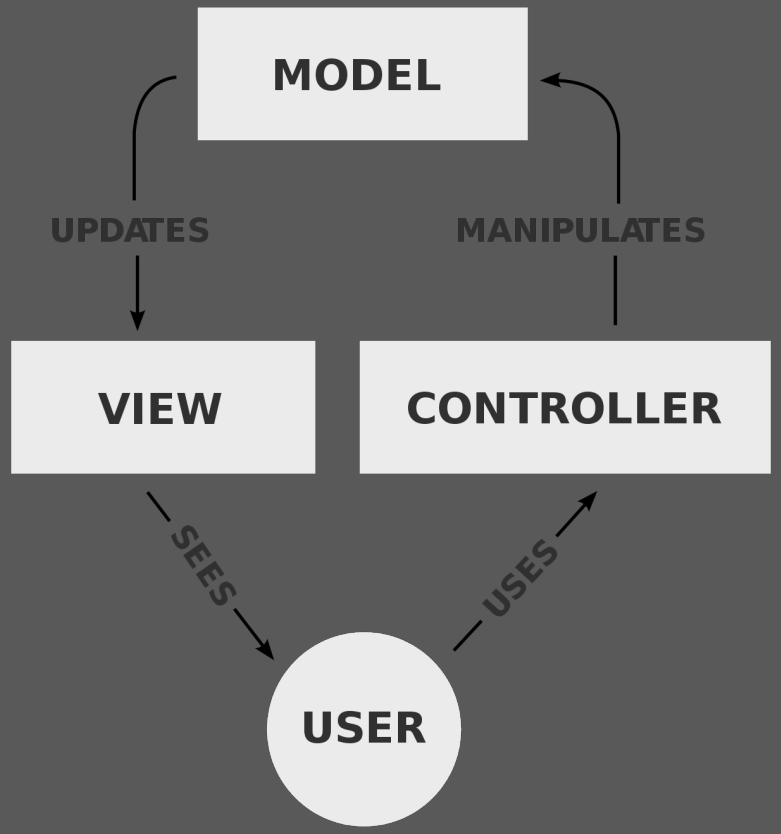

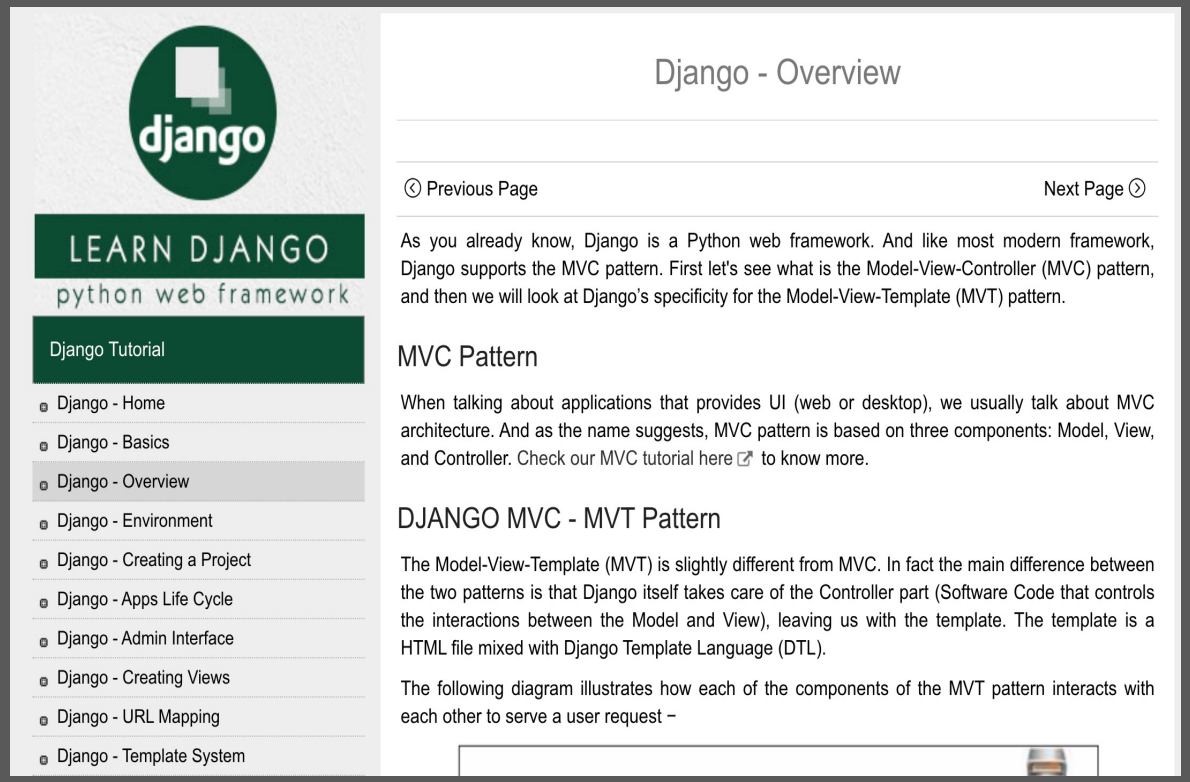

Dynamic Information Gathering

- Key principle 1: change is a useful primitive to inform mental models about a software system.
- Key principle 2: systems almost always provide some kind of starting point.
- Put simply:
  1. Build it.
  2. Run it.
  3. Change it.
  4. Run it again.
- Can provide information both *bottom up* or *top down*, depending on the situation.

Probes - Observe, control or “lightly” manipulate execution

- Printf(“here”)
- Turning on automatic debug info logging
- Breakpoints
- Sophisiticated debugging tools
  - Breakpoint, eval, step through / step over
  - (Some tools even support remote debugging)
- Delete debugging (equivalent of `kill -9`)

Step 0: sanity check basic model + hypotheses.

- Confirm that you can build and run the code.
  - Ideally *both* using the tests provided, *and* by hand.
- Confirm that the code you are running *is the code you built.*
- Confirm that you can make *an externally visible change*.
- How? Where? Starting points:
  - Run an existing test, change it.
  - Write a new test.
  - Change the code, write or rerun a test that should notice the change.
- Make sure the changes persist if you want them to.
  - Distinguish between source repository and build/deploy directories.

Demonstration: Live Coding