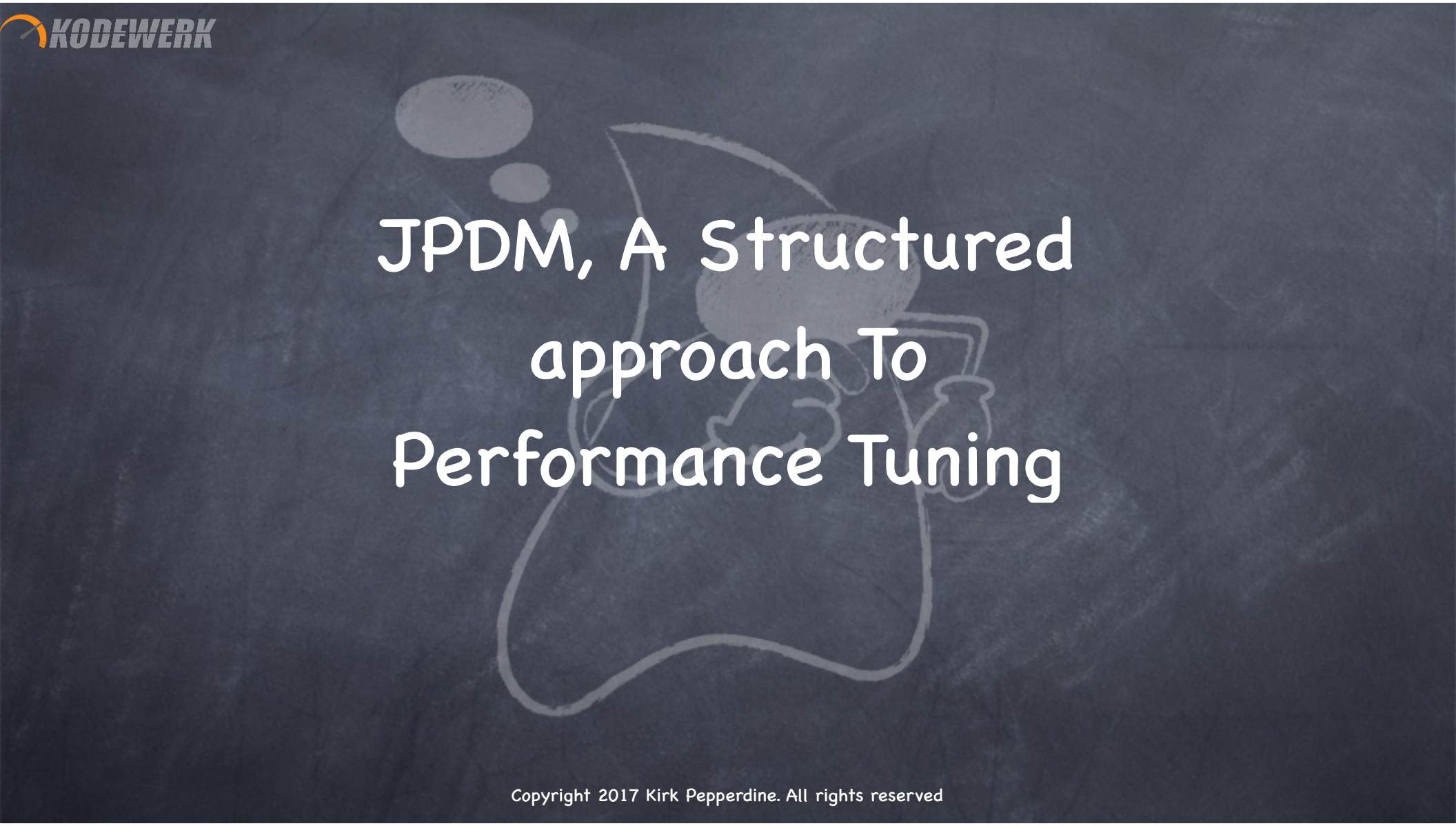
KODEWERK



JPDM, A Structured approach To Performance Tuning


About Me
Kodewerk Ltd Performance Consulting
Java Performance Tuning Workshops
Co-Founded jClarity
Java
Champions

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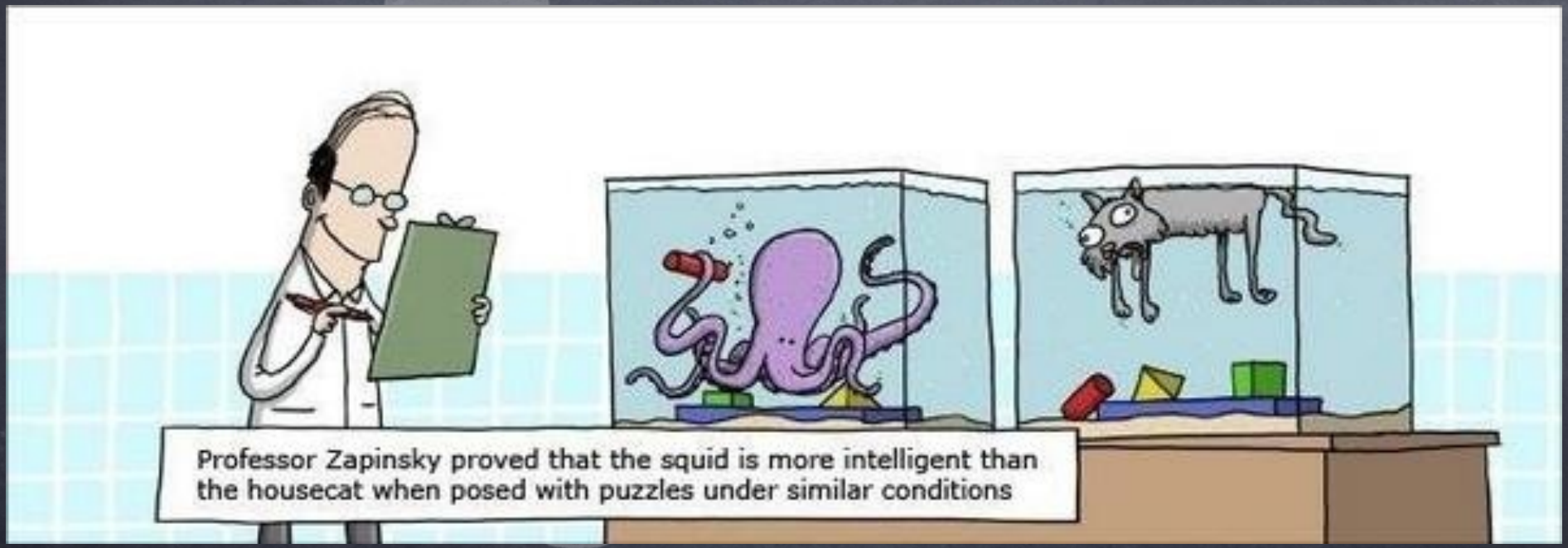
Disclaimer



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Our Typical Customer

- Application isn't performing to project sponsors expectations
  - users wait for minutes for the application to respond


iPad

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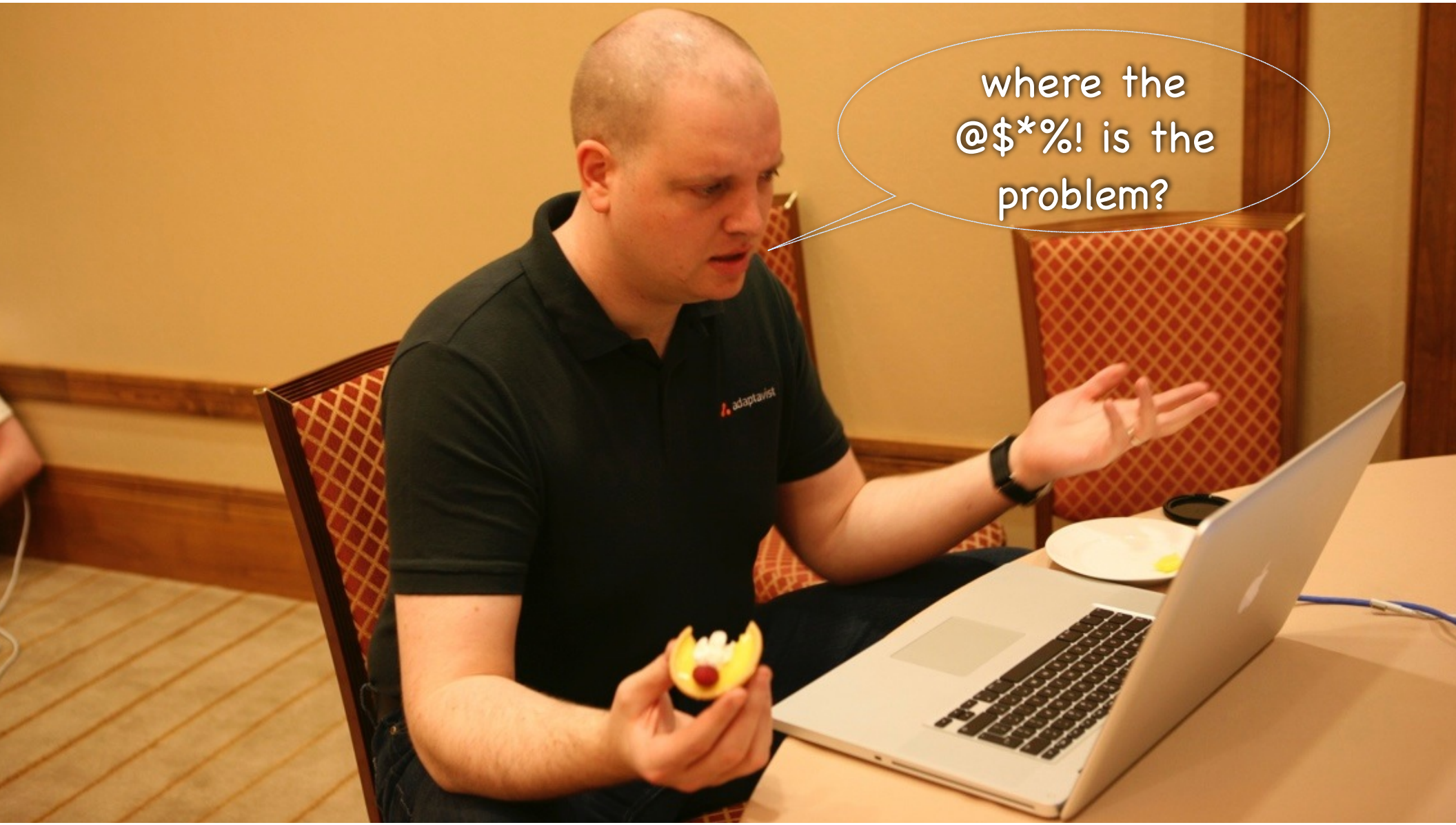
Developers Get Involved

StringBuffer is being used all over the place...
We need to change it to StringBuilder

Looks like a database problem, we need to migrate to [buzzname goes here]


where the @$*%! is the problem?

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Managers Get Involved

Form a tiger team

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What is a Tiger Team?

A team of specialists in a particular field brought together to work on specific tasks.

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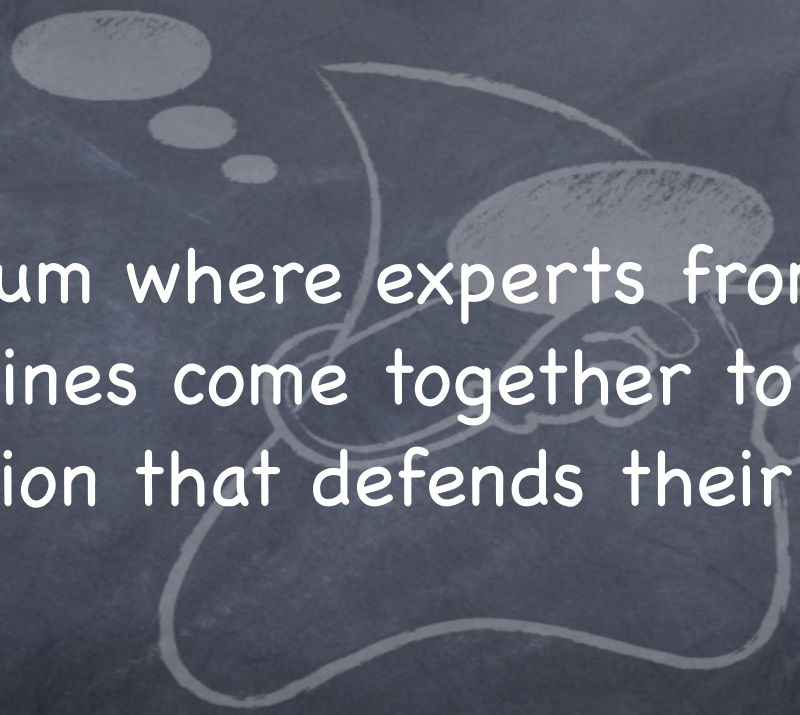
What is a Tiger Team?



A forum where experts from different disciplines come together to express an opinion that defends their specialty

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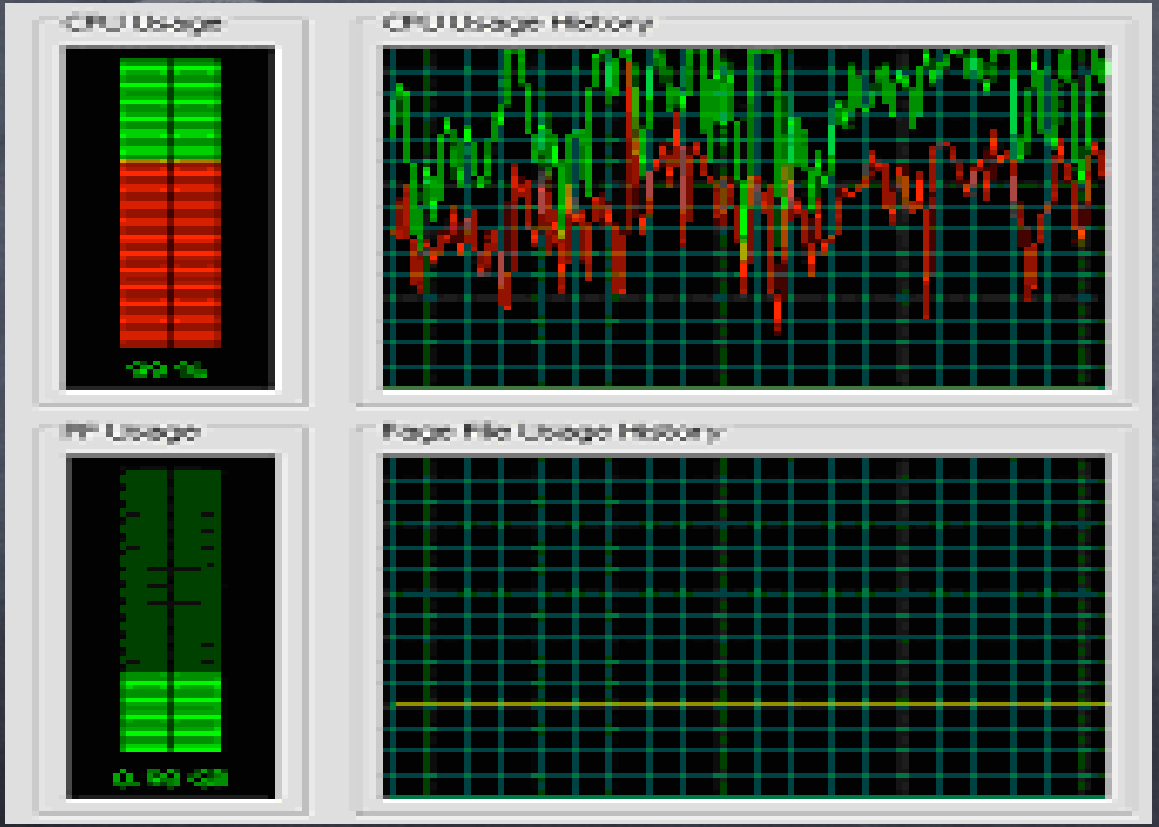
Measure Don't Guess®



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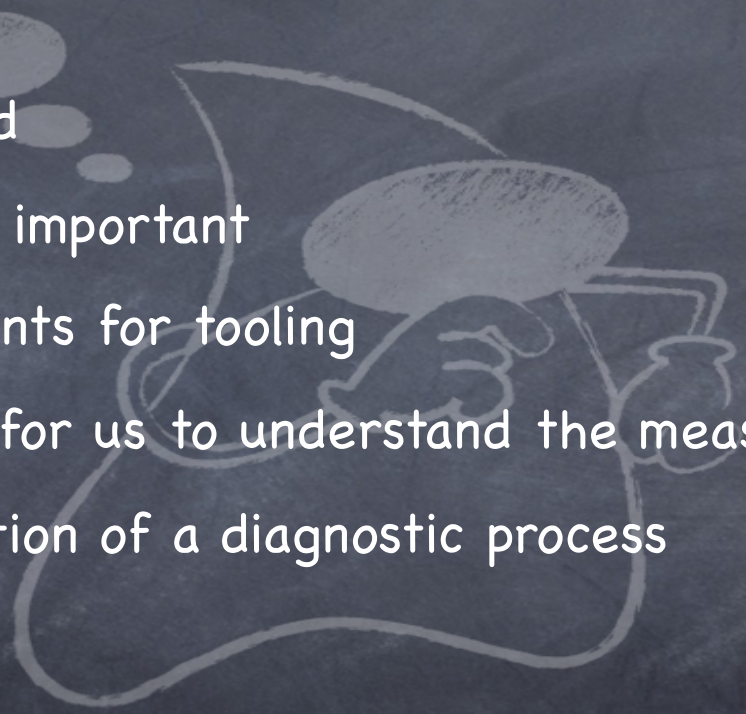
Why a System Model?



- Help us to understand
  - what measures are important
    - defines requirements for tooling
  - provides a context for us to understand the measures
  - facilitate the definition of a diagnostic process

- Java Performance Diagnostic Model (JPDM)

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Where do Developers Live?

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Developers Live Here

Application

Code (algorithms)

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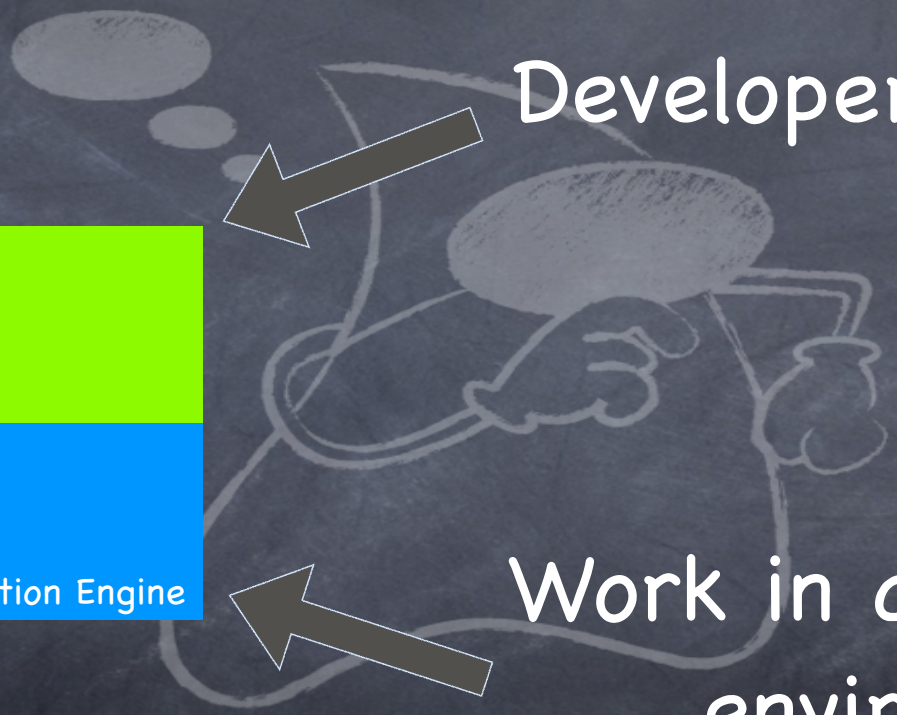

Developers Live Here

Application

Code (algorithms)

JVM

Managed Memory, Execution Engine

Work in a virtualized environment

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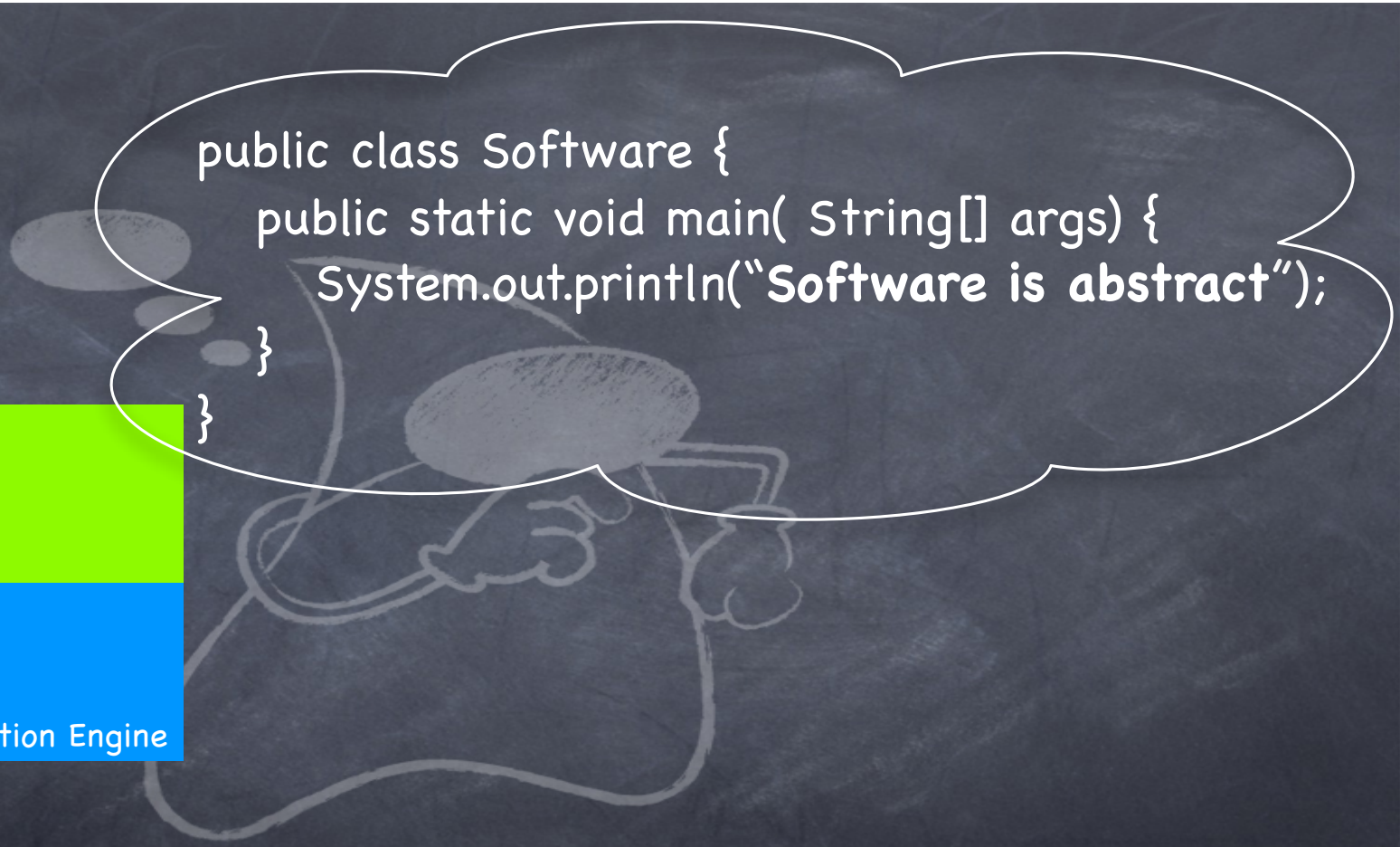

Application

Code (algorithms)

JVM

Managed Memory, Execution Engine

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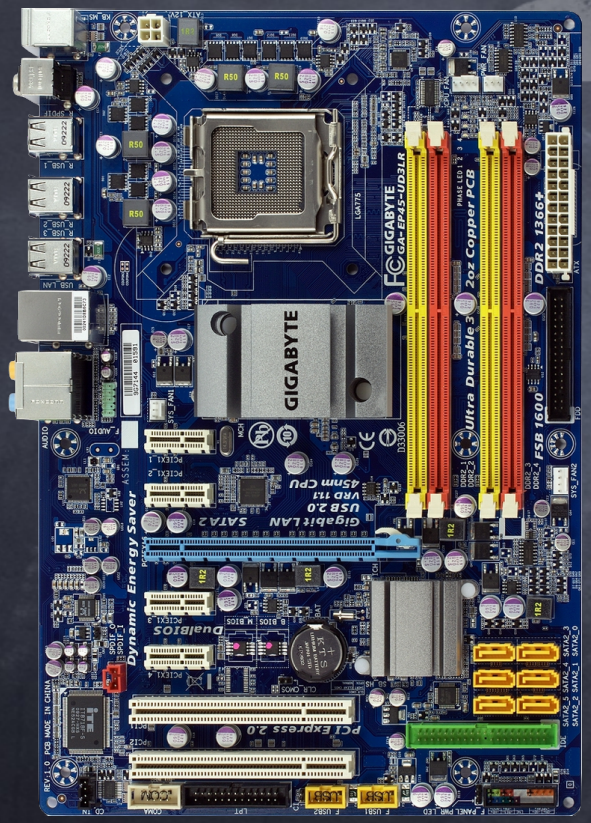
Hardware is Real!



- capacities
- volume
- throughput
- clock speed
- granularity
- cache line, sector size

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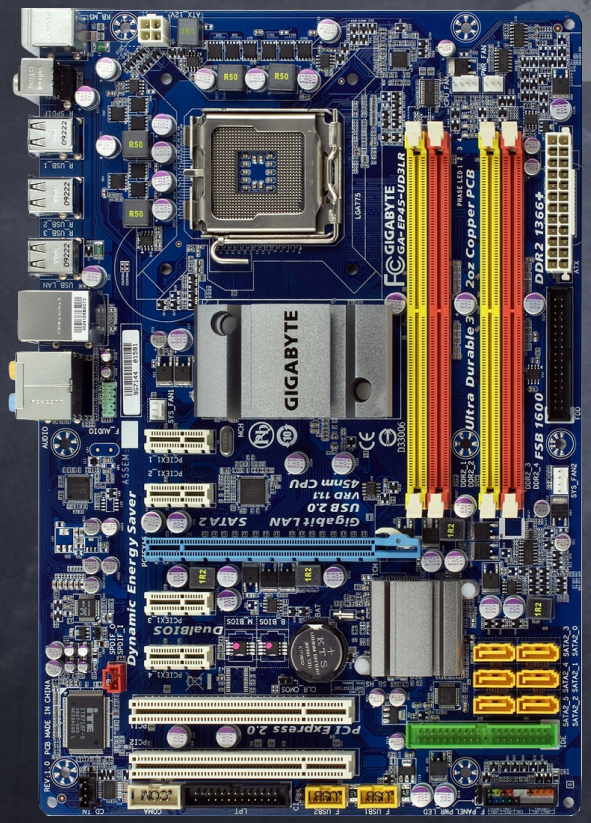
CPU



- capacity : number of cores
  - number of units in ALU
  - size of caches
- throughput : clock speed, CPI
  - bandwidth on various pipes (QPI)
- granularity : cache line size

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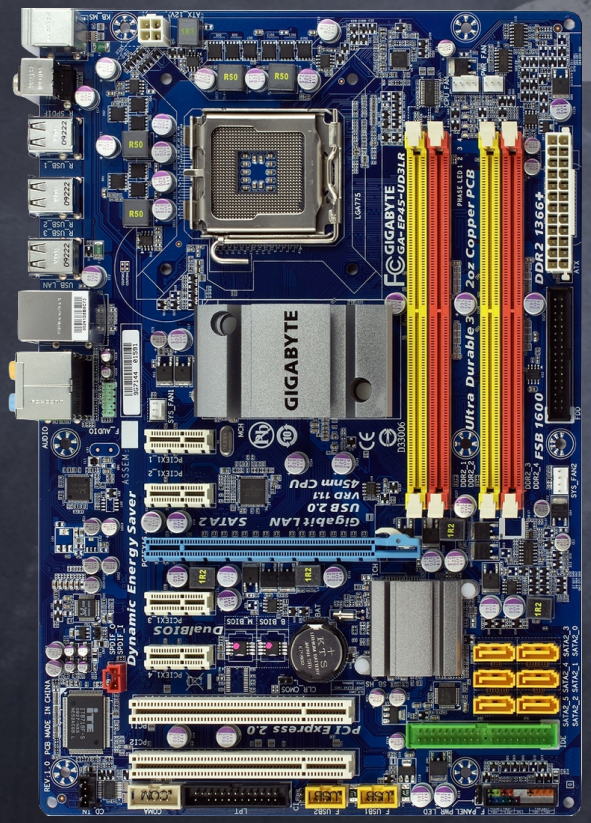
Memory



- capacity : number of bytes of RAM
- throughput : clock speed of BUS
  - tempered by bank cool of time
- chunk size : cache line size
  - typically 8 reads per cache line

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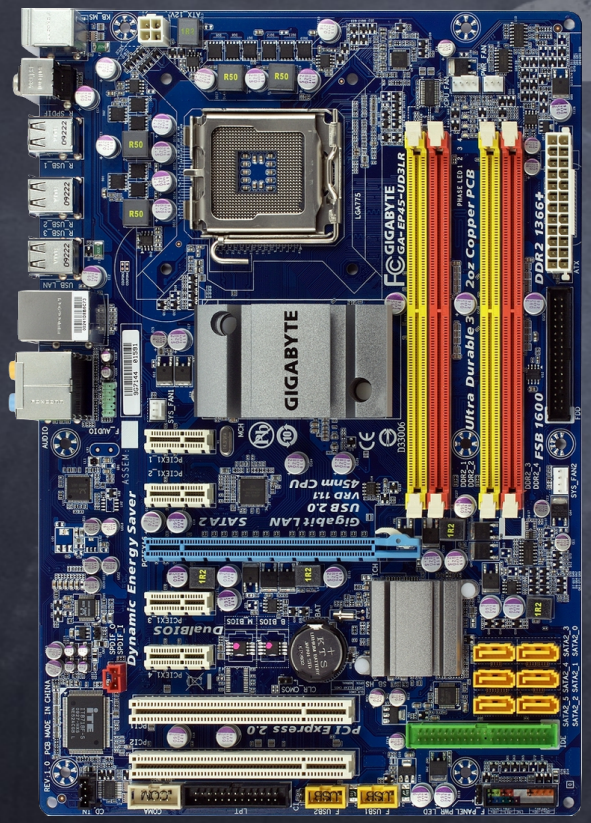
Disk



- capacity : number of bytes of RAM
- throughput : controller clock speed
  - ~1 Bbit/sec (SATA ~3Gbits/sec)
- granularity : disk sector (512 bytes)
- other latencies
  - sweep arm speed

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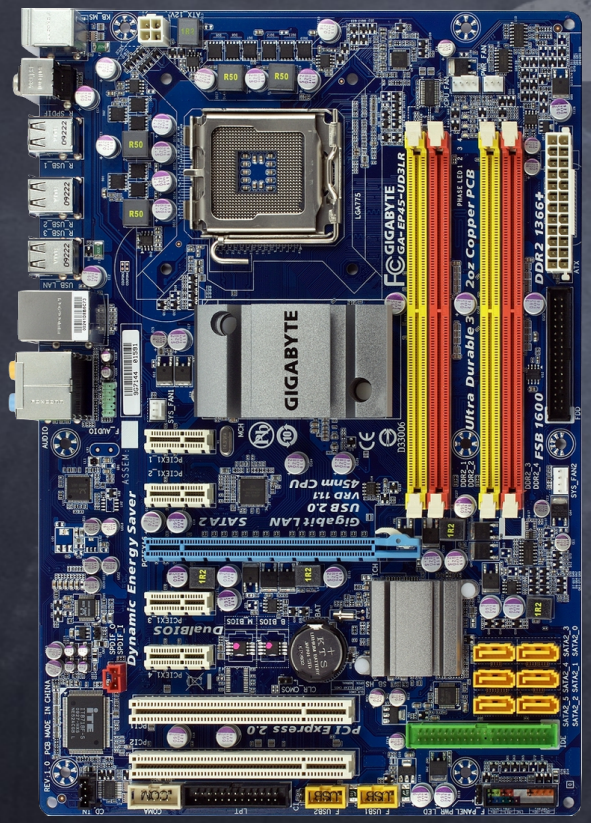
Network



- capacity : 1 per network card
- bandwidth : maximum volume of data transferred per second (10^9 bits/sec)
- throughput : depends on protocol overheads
- granularity : depends on protocol
  - tcp payload is typically 1500 bytes

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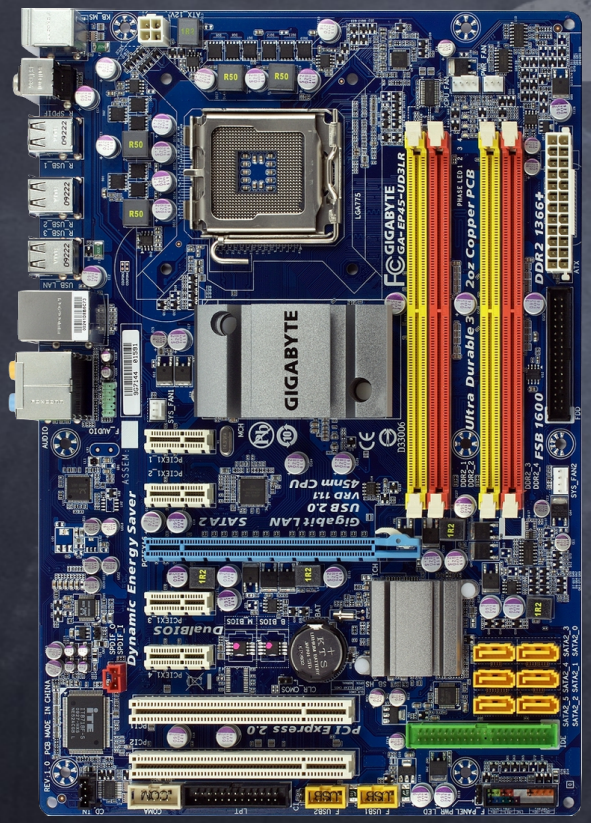
Other Limits



- Other hardware devices
  - eg, video, sound cards
  - GPU
- Heat
- Battery capacities

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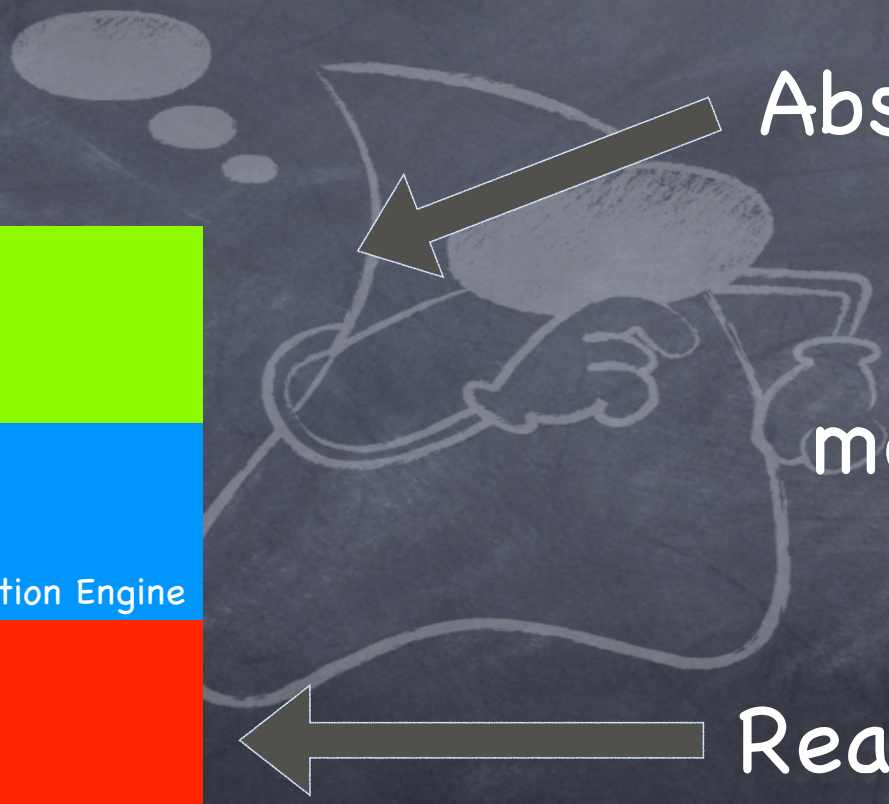


Abstract

meets

Reality

Application

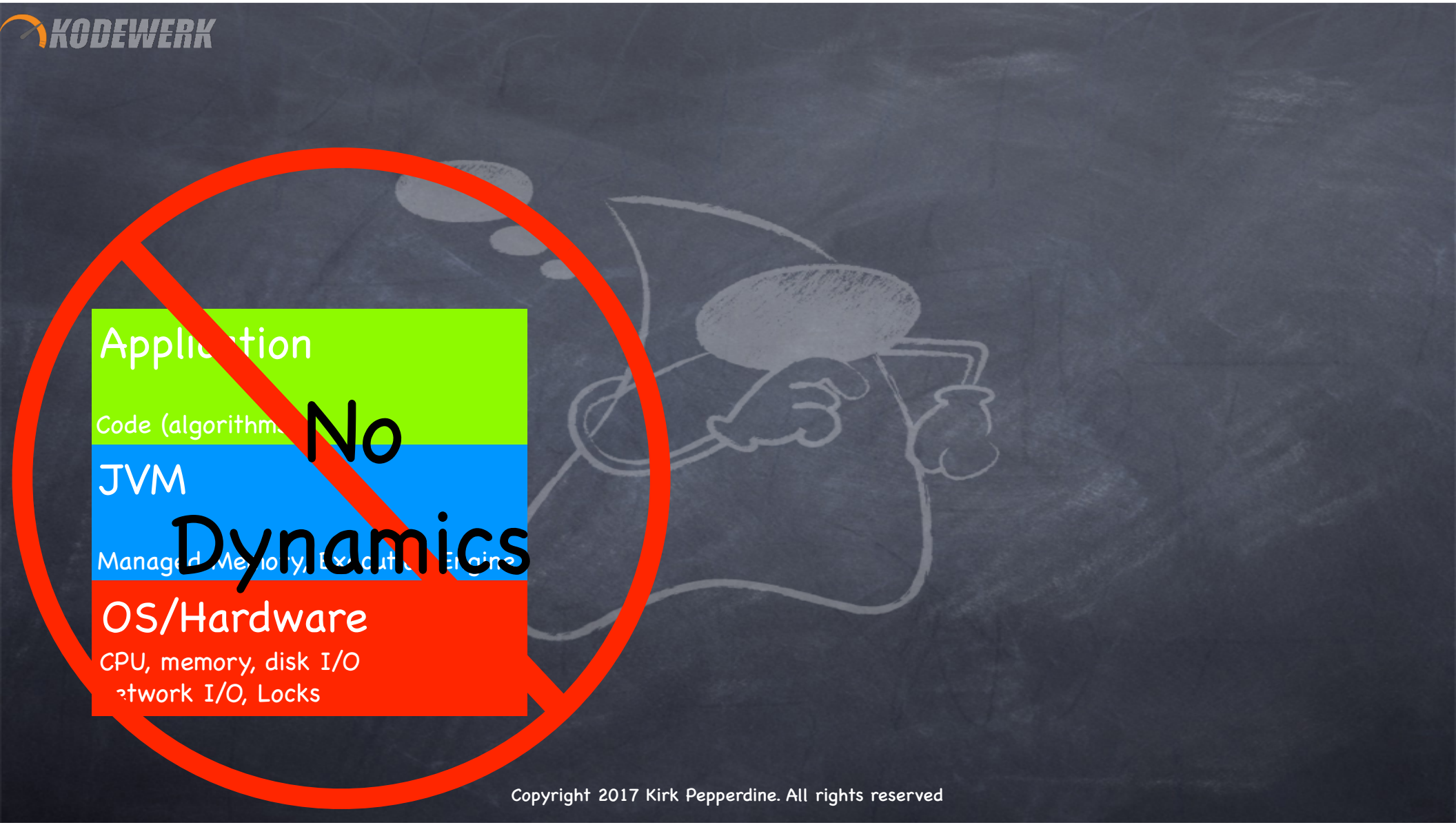
Code (algorithms)

JVM

Managed Memory, Execution Engine

OS/Hardware

CPU, memory, disk I/O
network I/O, Locks



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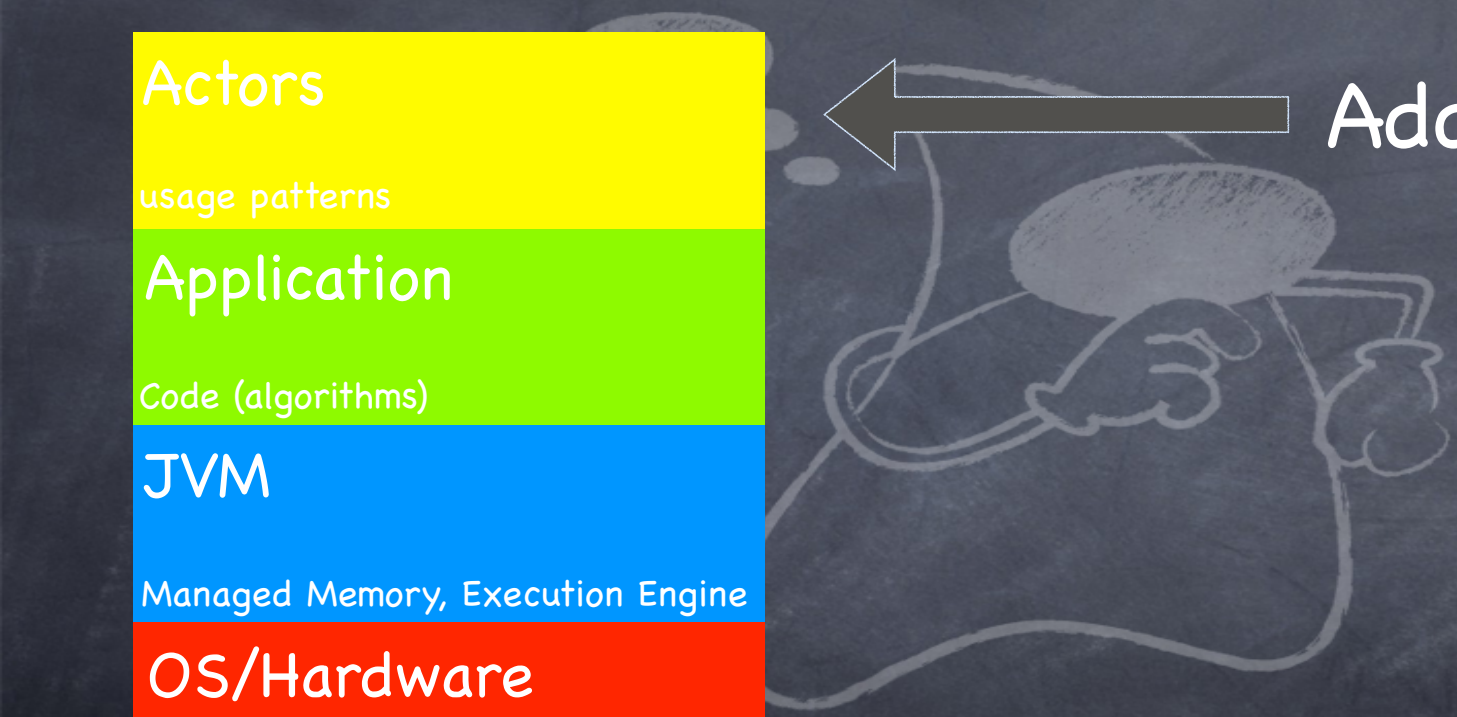

Actors

usage patterns

Application

Code (algorithms)

JVM

Managed Memory, Execution Engine

OS/Hardware

CPU, memory, disk I/O
network I/O, Locks

Add dynamics

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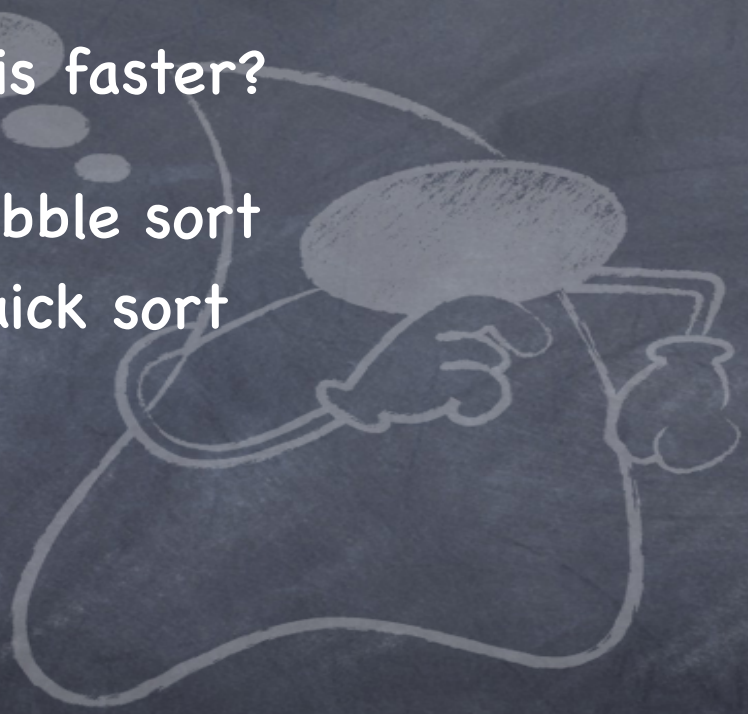
Question?

Which is faster?

a) Bubble sort

b) Quick sort



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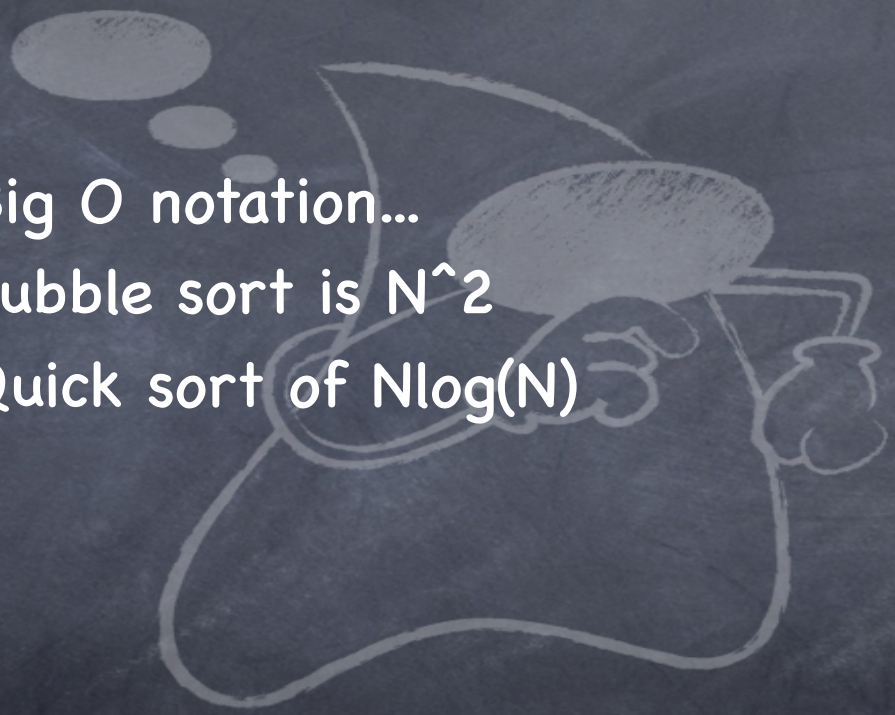
Hint



In Big O notation...

- Bubble sort is N^2
- Quick sort of Nlog(N)

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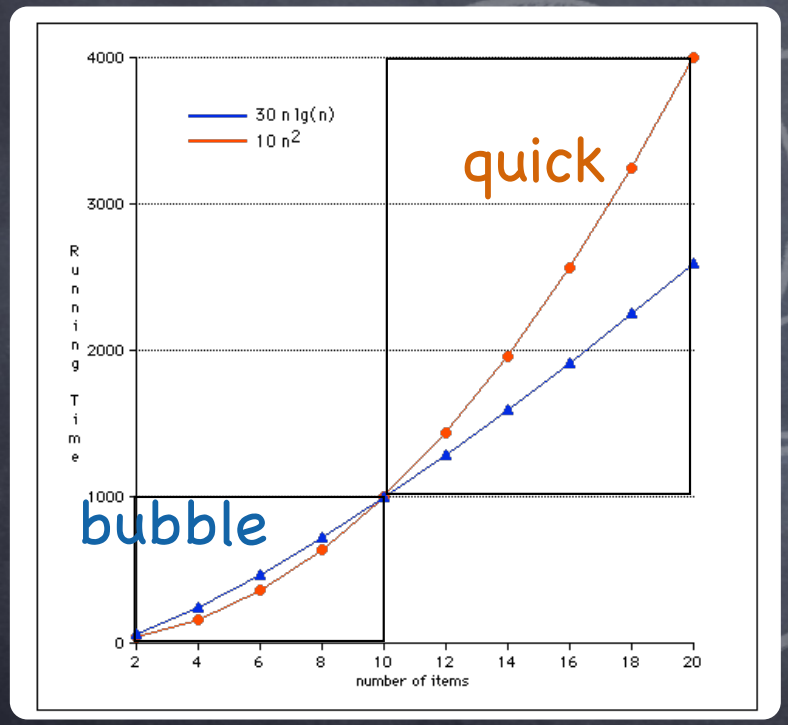
However



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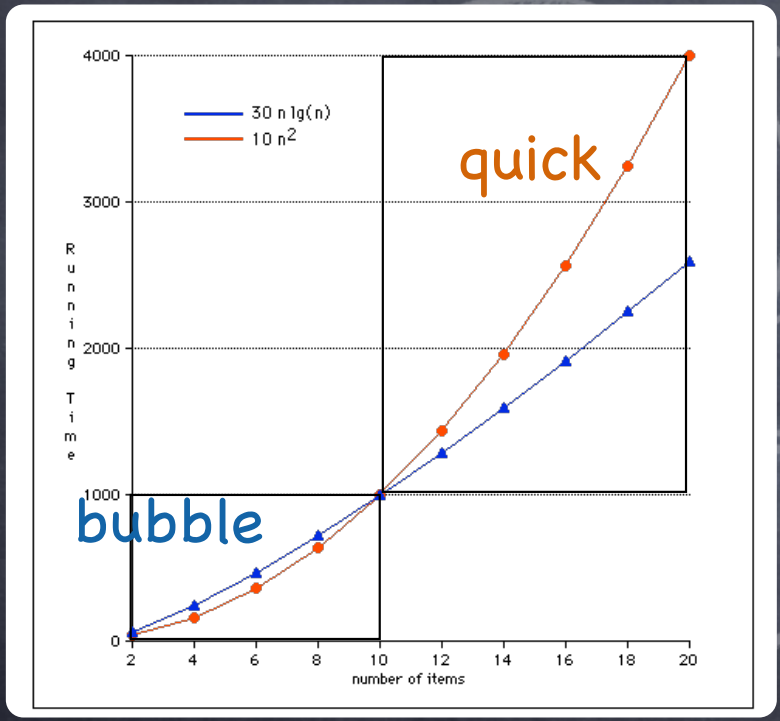
However



Number of items comes from the actors

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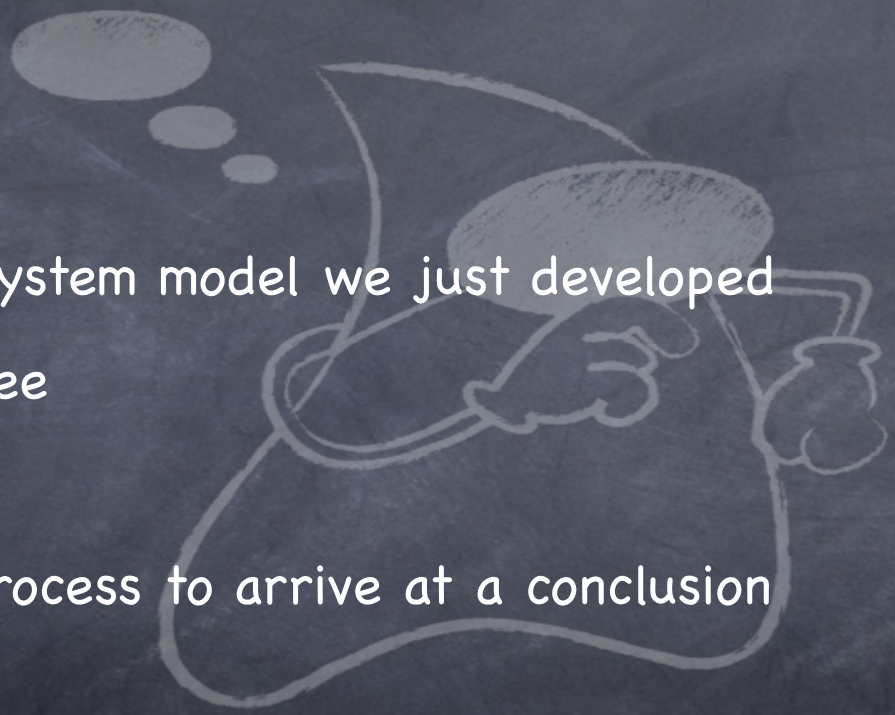
Performance Tuning Methodology



- Based on the System model we just developed
  - hypothesis free
  - methodical
    - step wise process to arrive at a conclusion

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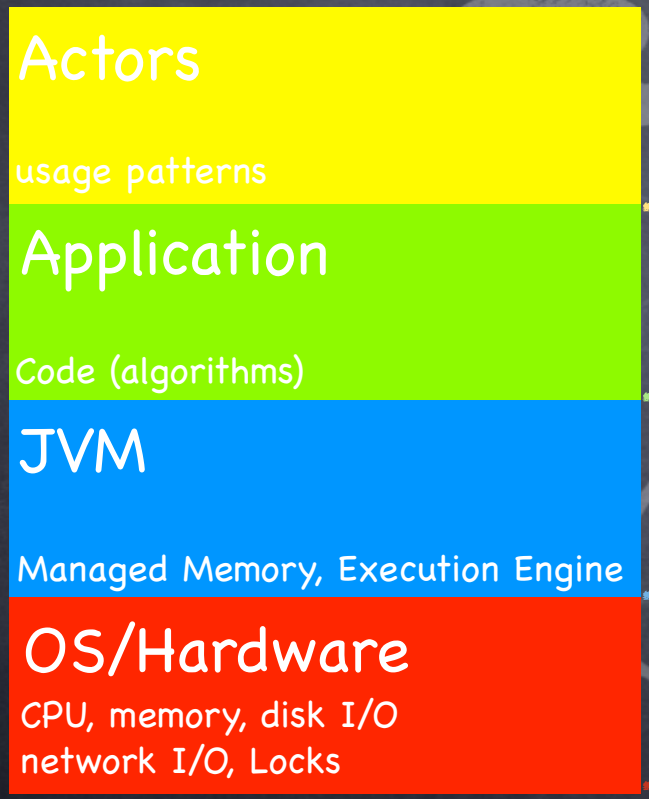
Hardware Consumption



- Actors drive the application
- Application drives the JVM
  - function of how actors interact with application
- JVM assisted by OS consumes Hardware
  - function of how application is coded
- Hardware is consumed
  - consumption limited by capacity
  - pattern of consumption is important

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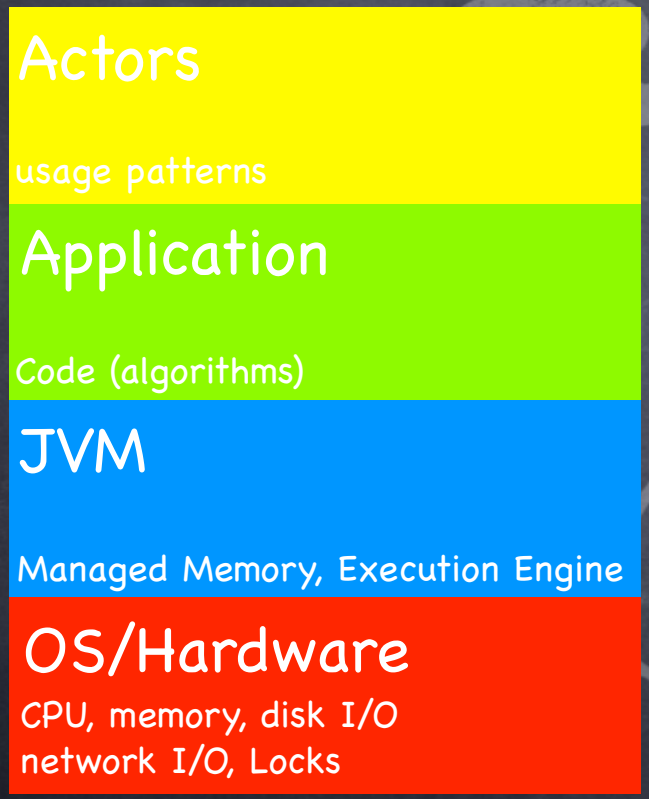
Dominating Consumer



- Activity that dominates how the CPU is utilized
- Determination dominator by analyzing
  - CPU counters
  - Garbage collection logs

garbage collection logs

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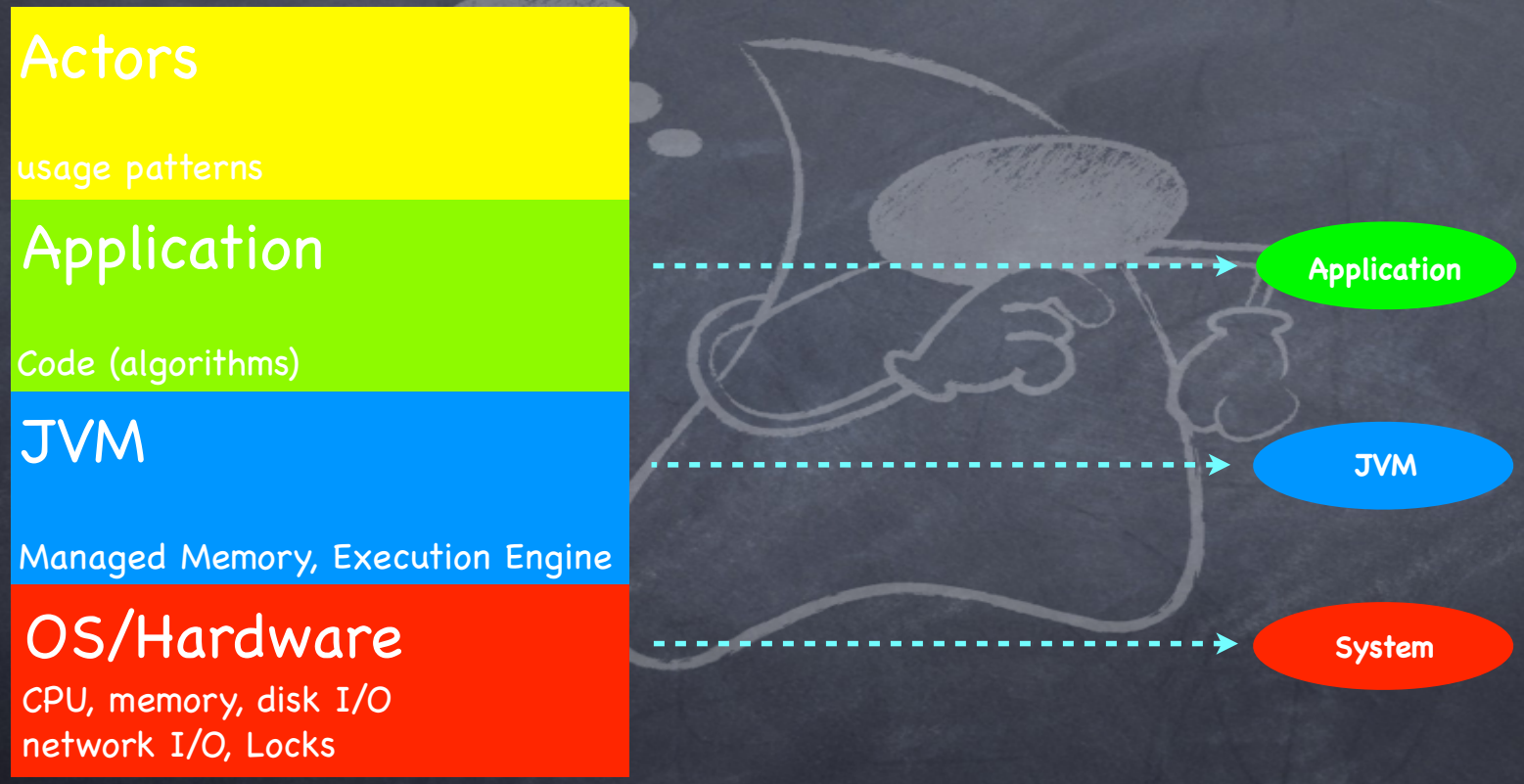
Dominating Consumers



• garbage collection logs

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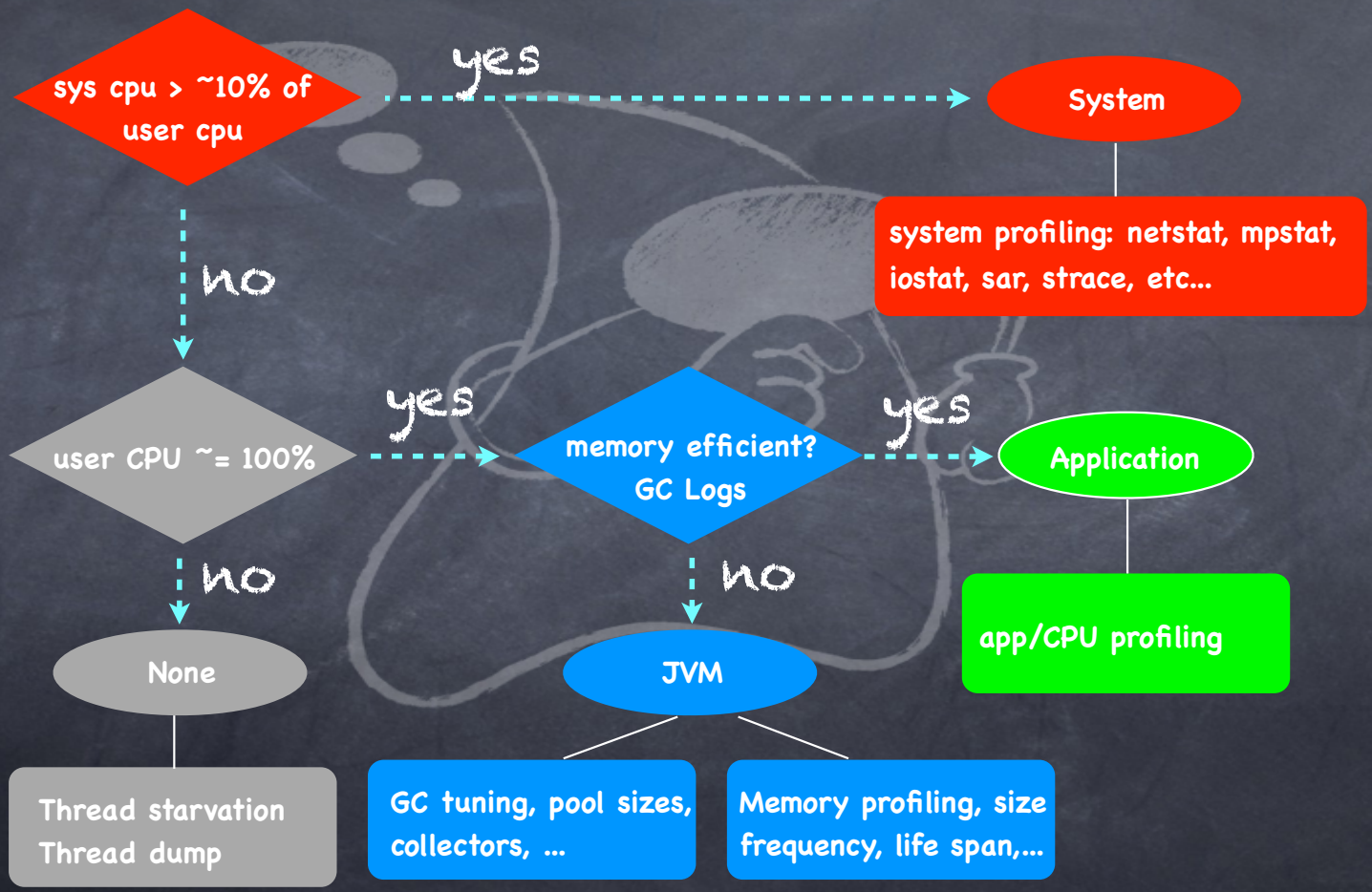
Analysis



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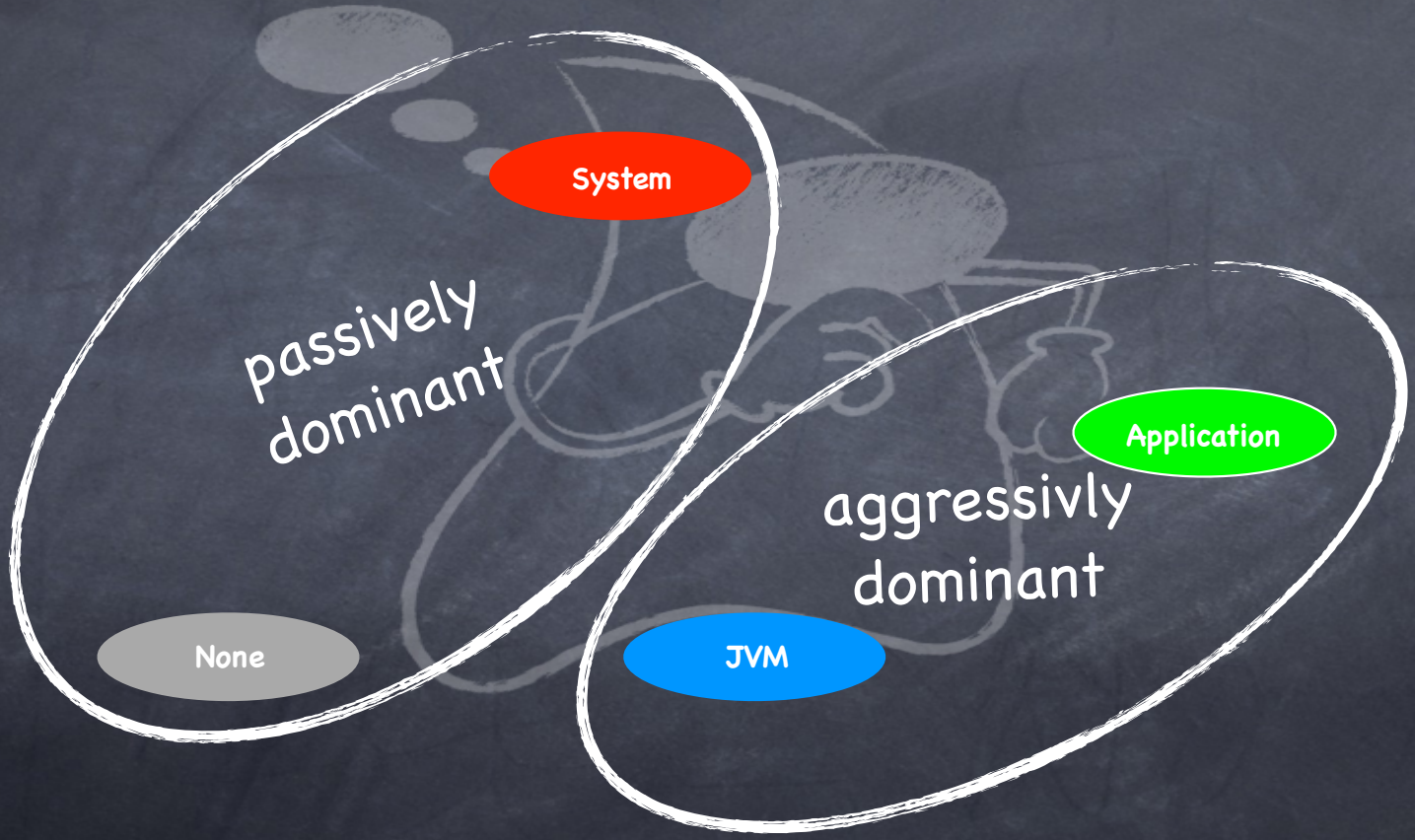
Expression of CPU Consumption



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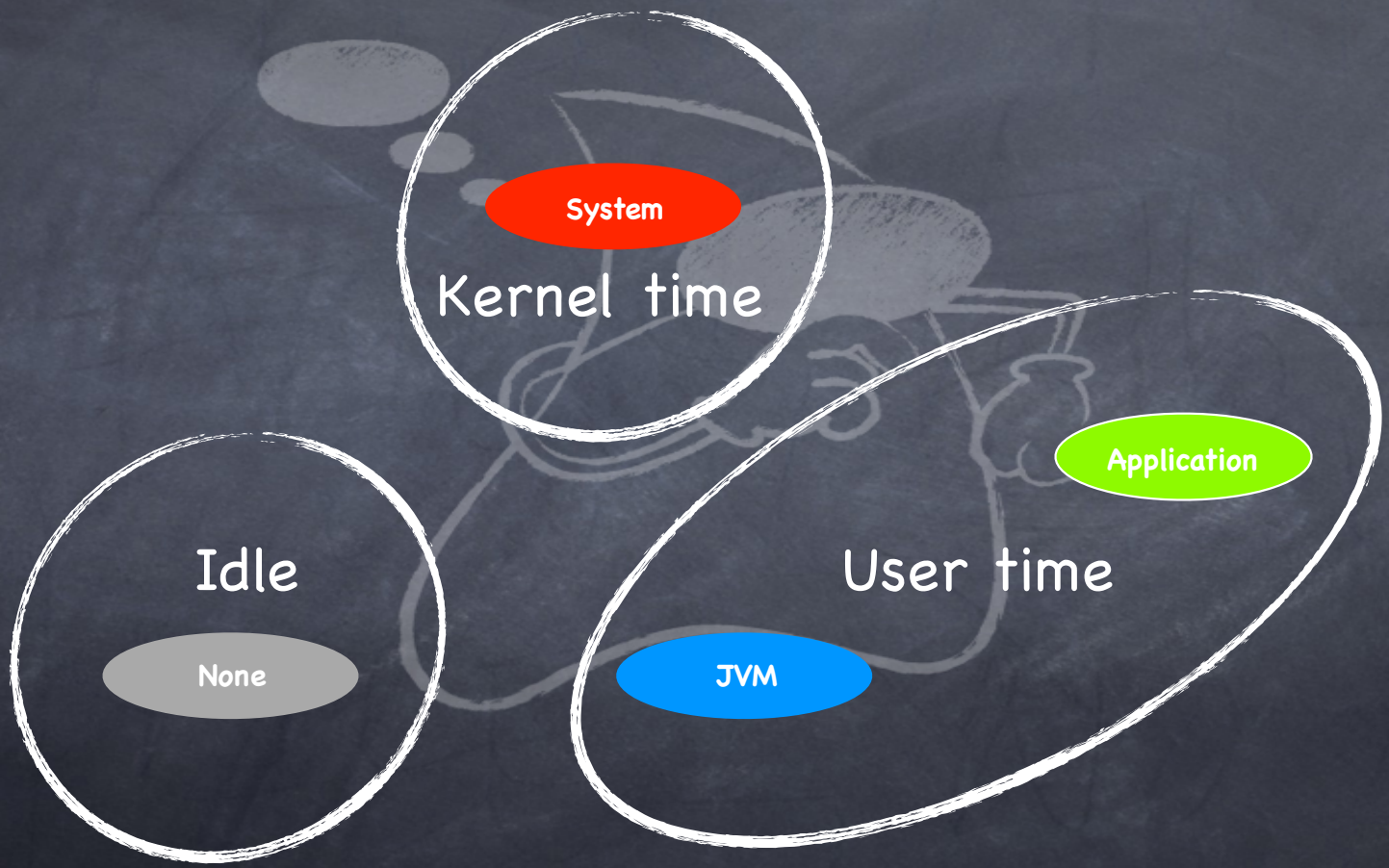
Measuring Consumption



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r	b	swpd	free	buff	cache	si	so	bi	bo	in	cs	us	sy	id	wa
3	9	100	24496	11096	13267036	0	0	0	5	0	1	2	1	96	1
3	2	100	23420	11088	13268328	0	0	0	0	77330	175352	17	26	39	17
3	9	100	20836	11088	13270628	0	0	0	68	105118	227382	14	40	21	25
8	4	100	23356	11080	13268272	0	0	0	0	80062	164387	12	30	29	30
7	7	100	23180	11084	13267068	0	0	0	72	98353	234851	15	43	28	15
11	2	100	25820	11088	13263676	0	0	0	120	100749	214921	11	42	17	30
13	1	100	22316	11088	13267176	0	0	0	0	103878	246723	16	56	19	9
4	3	100	21824	11088	13269140	0	0	0	0	48625	97288	15	16	9	60
11	2	100	20932	11080	13269808	0	0	0	0	110760	236774	14	41	24	20
1	12	100	23624	11084	13267488	0	0	0	204	69117	148611	15	27	25	33
7	5	100	24996	11096	13267476	0	0	0	164	24495	48552	13	10	30	48
1	12	100	20792	11096	13271872	0	0	0	0	25659	54331	8	9	26	56
6	8	100	21984	11080	13269920	0	0	0	20	46309	101404	16	18	51	15
4	9	100	22764	11080	13268956	0	0	16	0	88553	229557	17	35	38	11

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Benchmarking Process

```
Benchmark benchmark = new Benchmark()
benchmark.configure();
performance = benchmark.baseline(application);
user.setHappy(performance.meets(requirements));
while (( ! user.isHappy()) && (user.hasMoney())) {
    Profiler profiler = performance.identifyDominatingConsumer();
    profilingResults = benchmark.profile(profiler);
    application.fixUsing( profilingResults);
    while ( application.failsQA())
        application.debug();
    performance = benchmark.baseline(application);
    user.setHappy(performance.meets(requirements));
}
```

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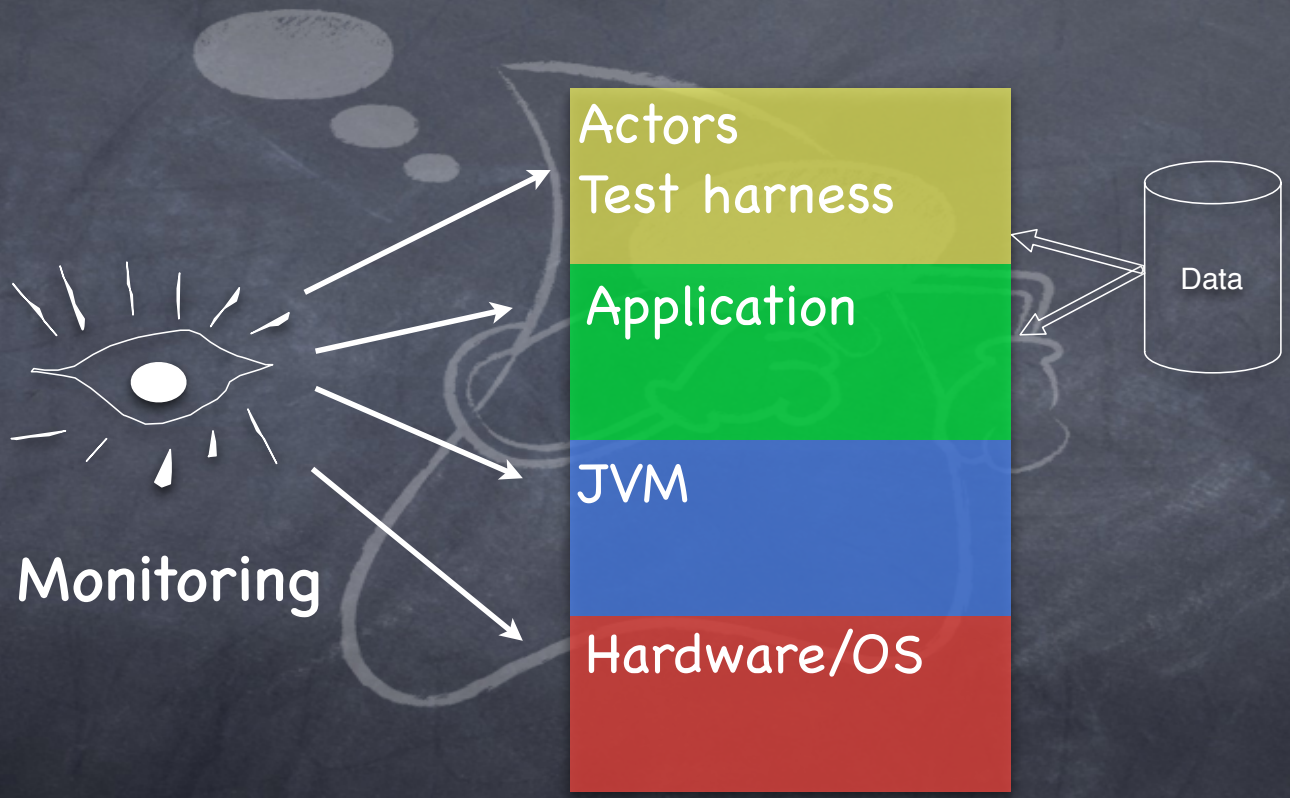
Things We Need



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Time for a demo

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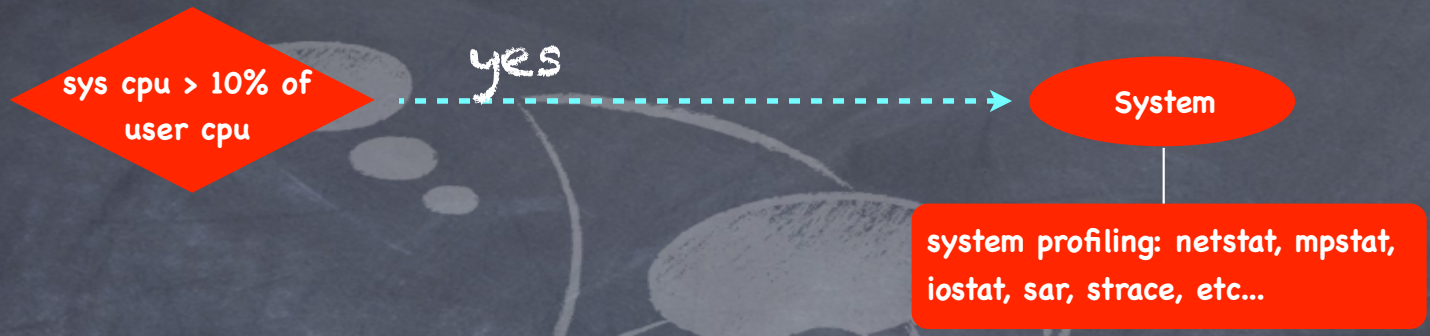
Dominating Consumer #1



- Question?
  - Why the high level of kernel CPU?
- Observations
  - no disk I/O, network activity or video
  - context switching due to lock contention?
- Monitor threads with VisualVM

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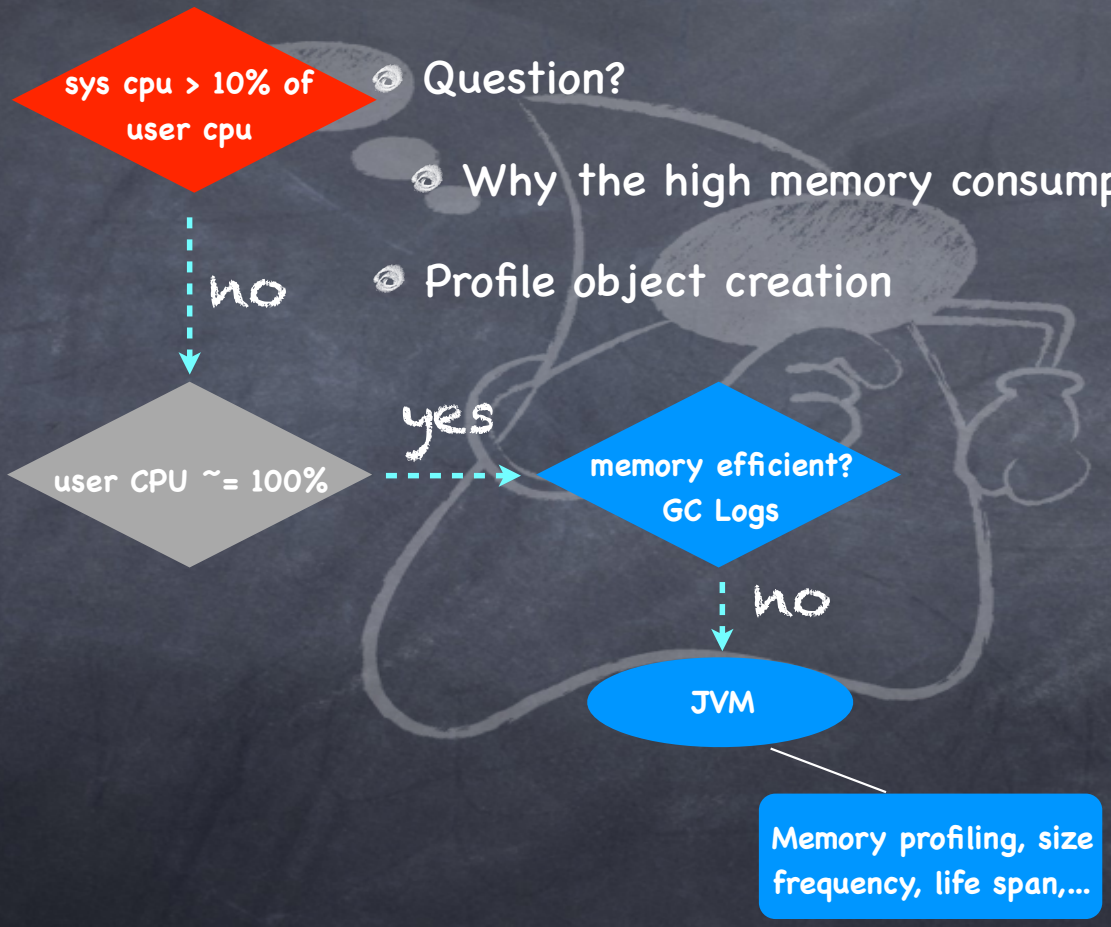
Dominating Consumer #2



- Question?
- Why the high memory consumption
- Profile object creation

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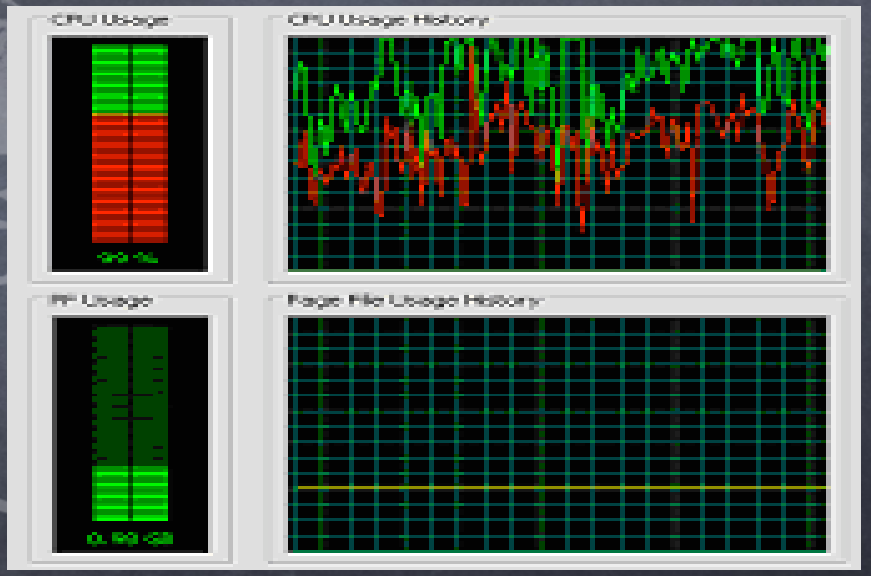
What About Our Customer

- Need to gather clear requirements
- Develop a sound benchmarking environment
  - get better measurements
- Always identify dominating consumer
  - refocus teams on problems that matter



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Questions?