SELF-AWARE APPLICATIONS
AUTOMATIC PRODUCTION DIAGNOSIS

DINA GOLDSHTEIN

Agenda

- Motivation
- Hierarchy of self-monitoring
- CPU profiling
- GC monitoring
- Heap analysis
- Deadlock detection

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- Heap analysis
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- Not today: profiling tools, 3rd party monitoring, dashboards

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  - Customized for specific business needs
  - Diagnostics flow from ground up
  - That’s what all the cool kids do :-)

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  - ETW, ClrMD

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  - ETW, ClrMD
- **Invasive** for deep-dive and concrete diagnostics
  - Memory leaks, bulk call-stack data (e.g. CPU profiling)
  - CLR Profiling API, CLR Debugging API, hooks

LET’S GET TO BUSINESS

(Self) CPU-Profiling

- Monitor CPU using performance counters
- Are we above a certain threshold for a certain amount of time?
  - Turn on ETW and collect stacks (live using LiveStacks)
  - Find hot paths, produce flame graphs
  - Suggest recommendations

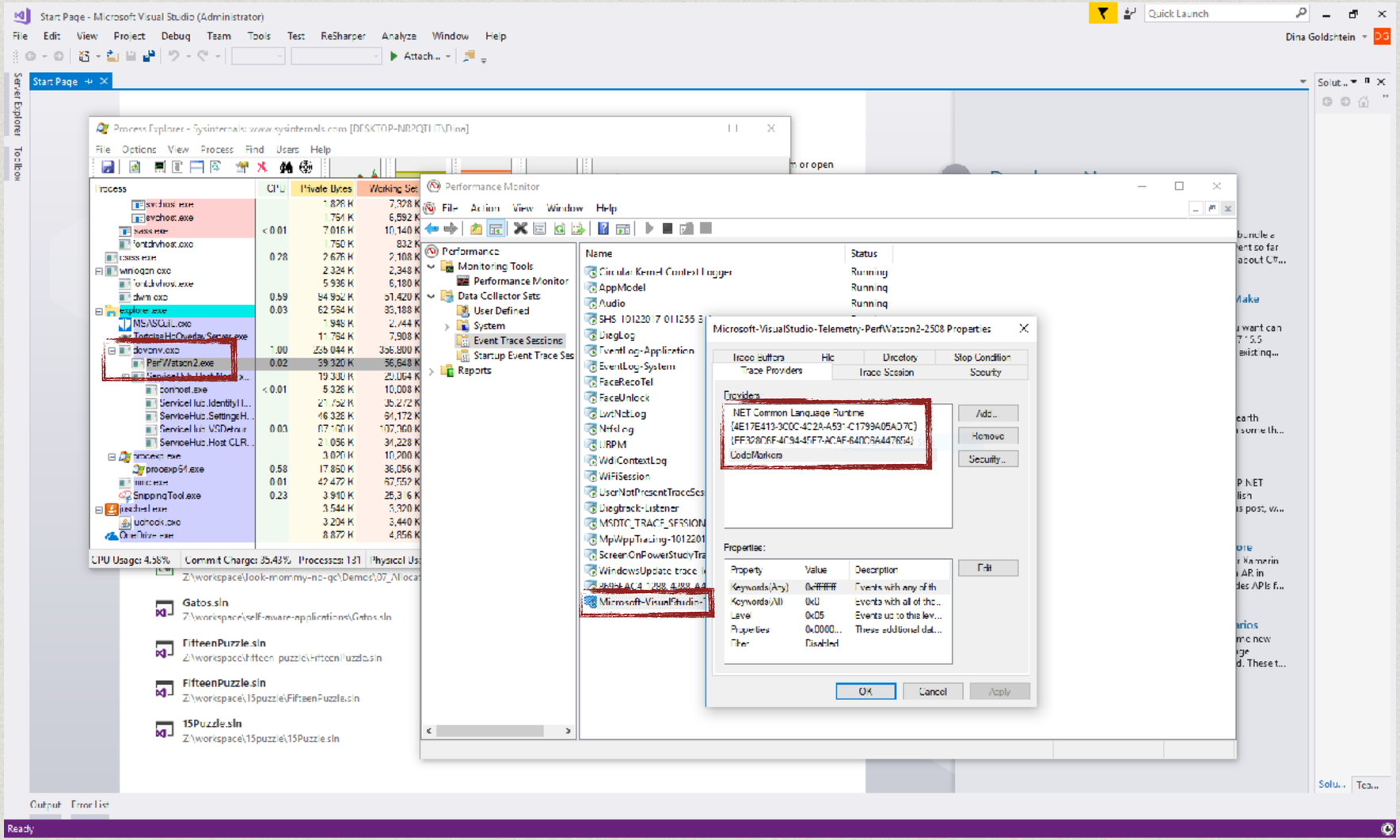
What Can Be Done?

- `AuthenticationController` takes 95% CPU, maybe we're being DDoS'ed
- Image processing component takes 100% CPU, need to auto-scale the app
- Encoding this 30 second video takes 3 minutes at 100% CPU, tell the user she can send us a bug report

DEMO

MONITOR FOR CPU SPIKES

This Is From Real Life



(Self) GC-Monitoring

- Monitor GC performance using performance counters
- Register on ETW's GC events such as `GCAllocationTick`
  - Types of objects allocated and their stacks(!)
  - Number of GCs of each kind and size of reclaimed memory
  - Duration of GC pauses
- Attach ClrMD to get heap breakdown
  - Generations, segments, reserved/committed, number of objects

DEMO

MONITOR FOR ALLOCATION SPIKES

(Self) Heap Analysis

- Monitor memory usage using performance counters
- Has memory increased above a certain threshold for a certain time?
  - Attach ClrMD to get heap statistics
  - Compare snapshots
  - Report which objects are not freed
  - Combine with ETW `GCAllocationTick` to get rate of allocation

DEMO

FIND A LEAK

(Self) Deadlock Detection

- Monitor for potential deadlock
  - Low CPU
  - Request timeouts
  - Increased thread count
- Attach ClrMD to create wait chains and detect deadlocks
- Report, try to break, pray for a miracle…

DEMO

DETECT A DEADLOCK

Food for Thought

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- Native memory leak analysis using ETW
- Side notes:
  - ClrMD is also very suitable for automating crash dump analysis
  - You can automate opening tickets in bug tracker, consolidate same issue from different users, versions, etc.

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  - Adds complexity (reduce risk by using separate process)
  - Adds overhead
  - Requires additional development

Summary

- Self-monitoring is important for all kinds of software
- Best to create a hierarchy of monitoring (and overhead and complexity)
- Lots of scenarios: CPU, GC, memory, deadlocks
- Demos: https://github.com/dinazil/self-aware-applications

THANK YOU

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