Final presentation master lab

A visual artifact detector for ITS.APE

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Structure

What's ITS.APE and why does it need a detector?

ITS.APE: IT-Security Awareness Penetration Testing Environment

- Framework for human pentesting [Syk15]

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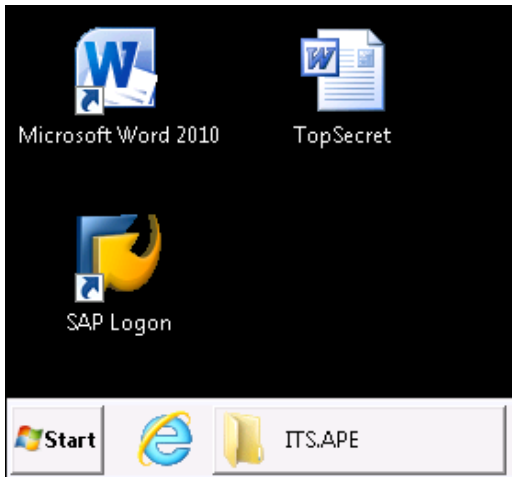
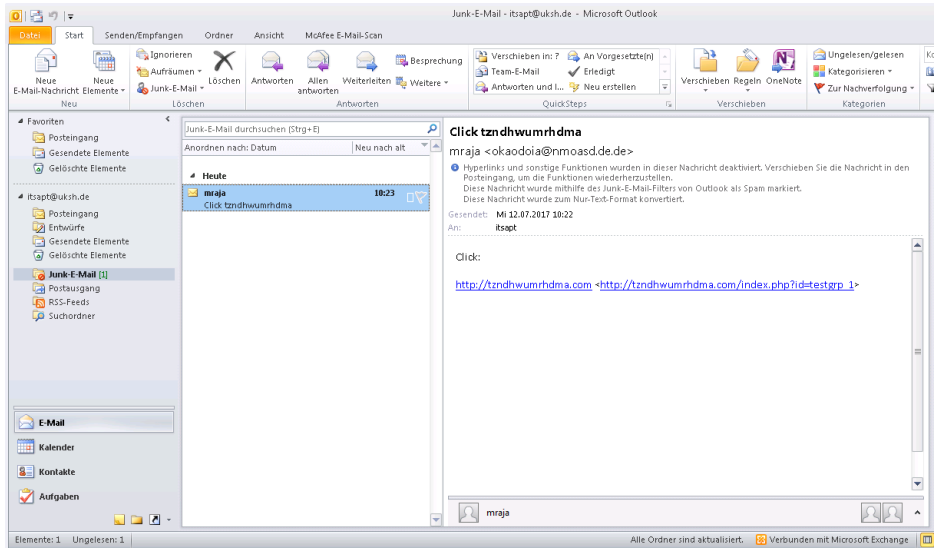
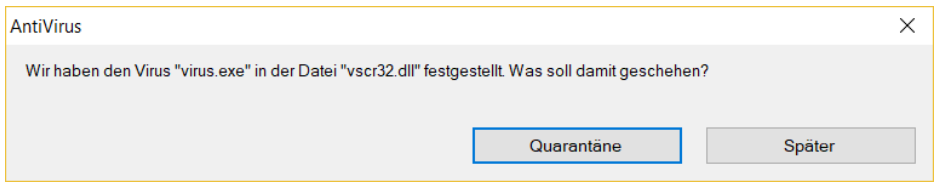
When to start measuring? $\Rightarrow$ Visibility in user's desktop

Artifact's visual cues – examples







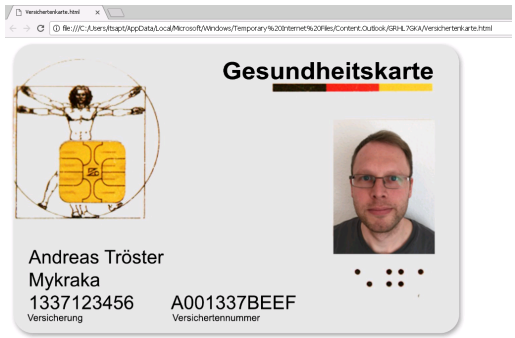


Figure: Examples for artifacts' reference images

A new tool: The VAD

VAD: Visual artifact detector
Measures of quality:

1. High rate of successful detection (*sensitivity*, *detection rate*)
2. Low resource consumption (esp. runtime)

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Target environment: Low-tier office hardware (Windows 7)
$\Rightarrow$ Runtime of at most several seconds
$\Rightarrow$ No CUDA, Windows 7 32 bit console application

Software design

- Separate tool from ITS.APE client service
- Same machine as client: User's privacy

Major design decisions

- Image recognition library $\Rightarrow$ OpenCV [The19]
- Wrapper Emgu CV (3.4.3) to use in C# [Can18]
- .NET Framework (4.7.2) [Kri18]
- Installer setup

How is it implemented?

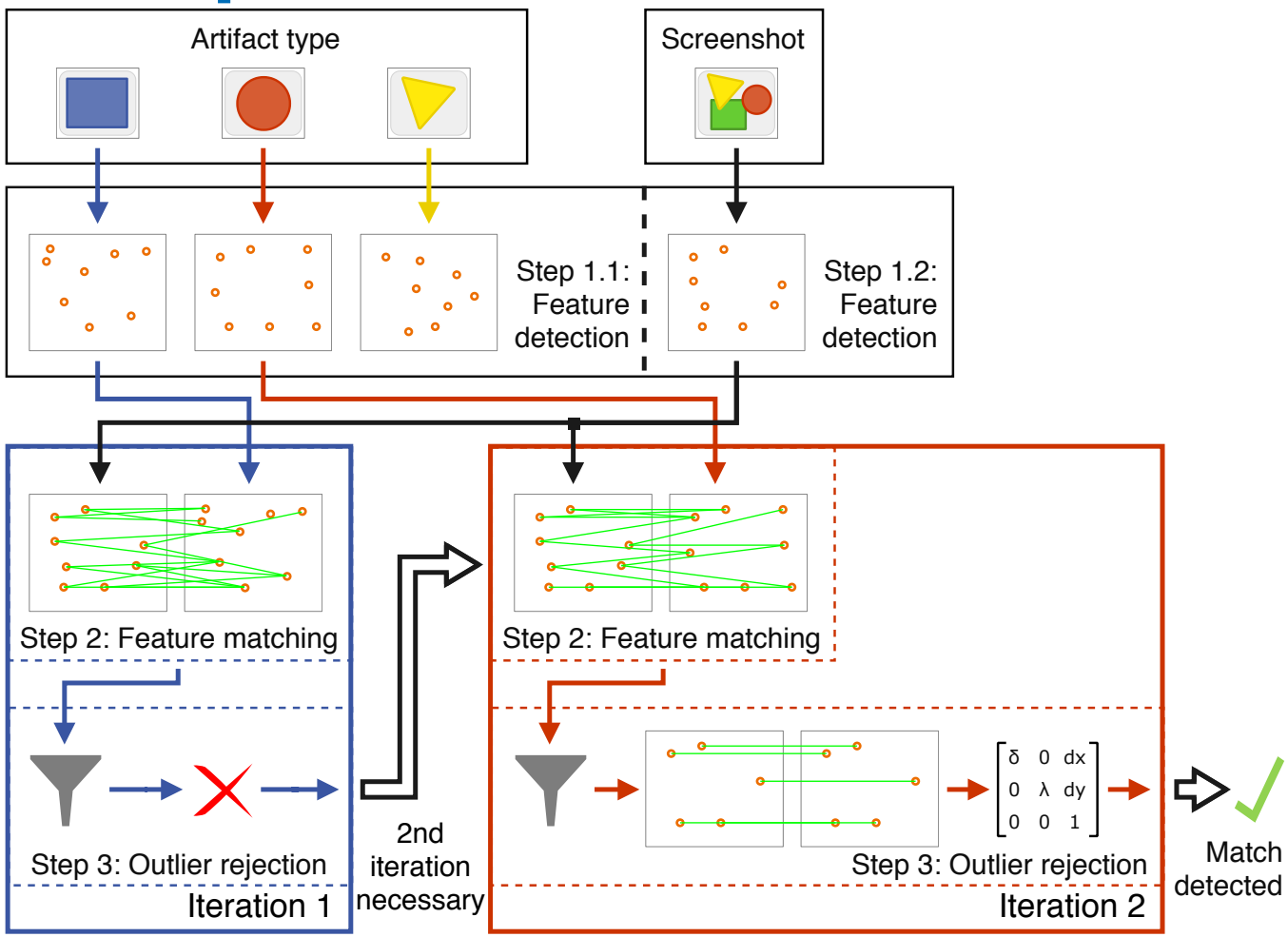

Figure: Exemplary recognition process diagram.

Evaluation of the implementation

- Virtual machine, Oracle's VirtualBox [Ora19]
- Virtual CPU with 1.4 GHz
- 2GB of RAM
- Windows 7 without any other software

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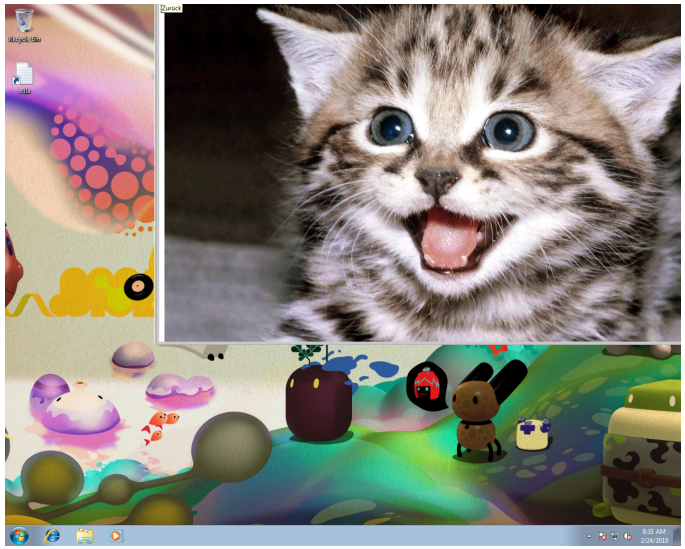
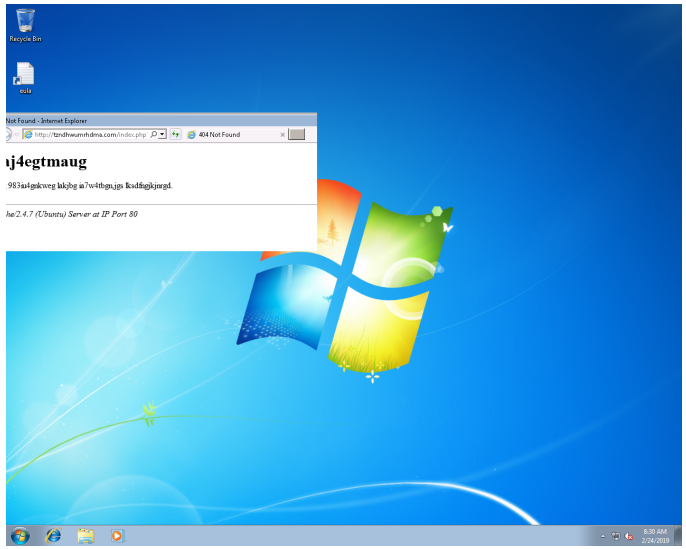
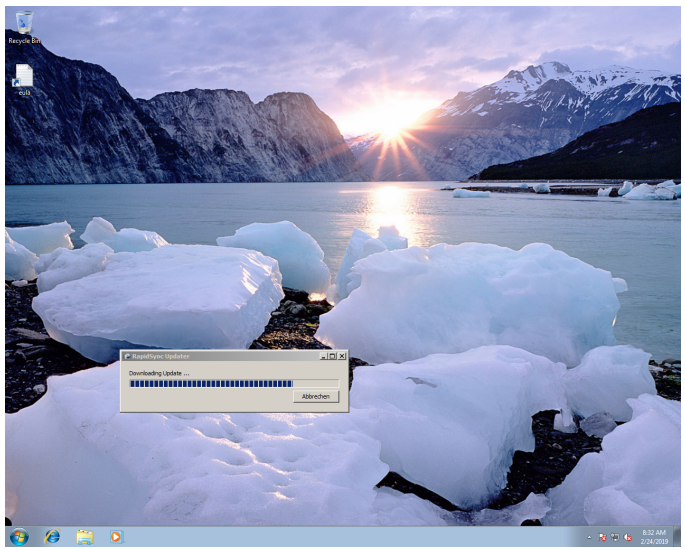
First setup for evaluation:

- 25 artifact types from recipes repository (A 1 to A 25)
- 365 screenshots generated (see next slide)
- 9125 executions of the VAD







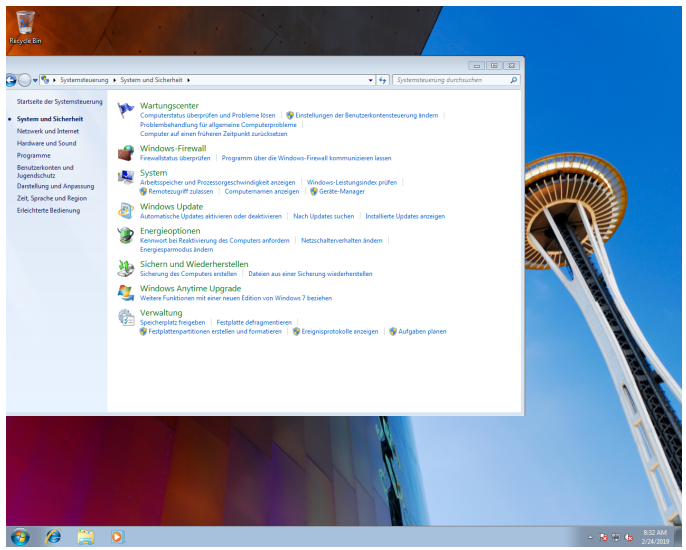


Figure: Examples for screenshots of first evaluation setup.

Results for the detection rate

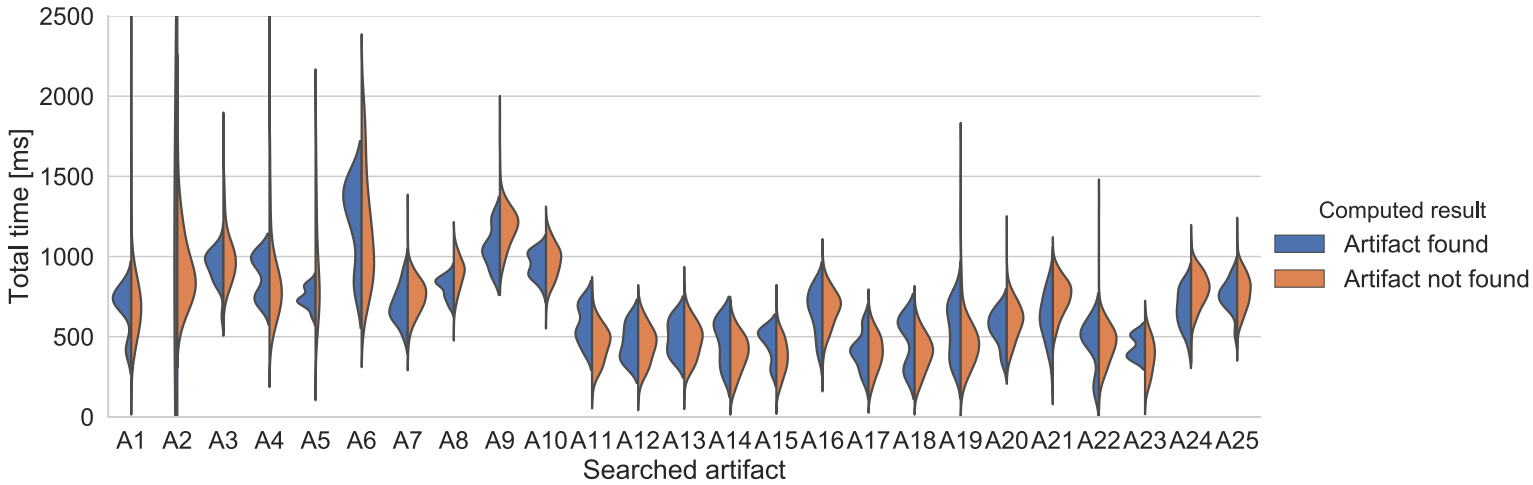
sum measured / sum goal	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	A 9	A 10	A 11	A 12	A 13
TP	$\frac{10}{10}$	$\frac{9}{10}$	$\frac{15}{15}$	$\frac{7}{10}$	$\frac{9}{10}$	$\frac{4}{5}$	$\frac{20}{20}$	$\frac{8}{15}$	$\frac{4}{5}$	$\frac{11}{15}$	$\frac{5}{5}$	$\frac{4}{5}$	$\frac{4}{5}$
TN	$\frac{355}{355}$	$\frac{355}{355}$	$\frac{345}{350}$	$\frac{355}{355}$	$\frac{355}{355}$	$\frac{360}{360}$	$\frac{345}{345}$	$\frac{350}{350}$	$\frac{360}{360}$	$\frac{345}{350}$	$\frac{360}{360}$	$\frac{360}{360}$	$\frac{360}{360}$
FP	$\frac{0}{355}$	$\frac{0}{355}$	$\frac{5}{350}$	$\frac{0}{355}$	$\frac{0}{355}$	$\frac{0}{360}$	$\frac{0}{345}$	$\frac{0}{350}$	$\frac{0}{360}$	$\frac{5}{350}$	$\frac{0}{360}$	$\frac{0}{360}$	$\frac{0}{360}$
FN	$\frac{0}{10}$	$\frac{1}{10}$	$\frac{0}{15}$	$\frac{3}{10}$	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{0}{20}$	$\frac{7}{15}$	$\frac{1}{5}$	$\frac{4}{15}$	$\frac{0}{5}$	$\frac{1}{5}$	$\frac{1}{5}$

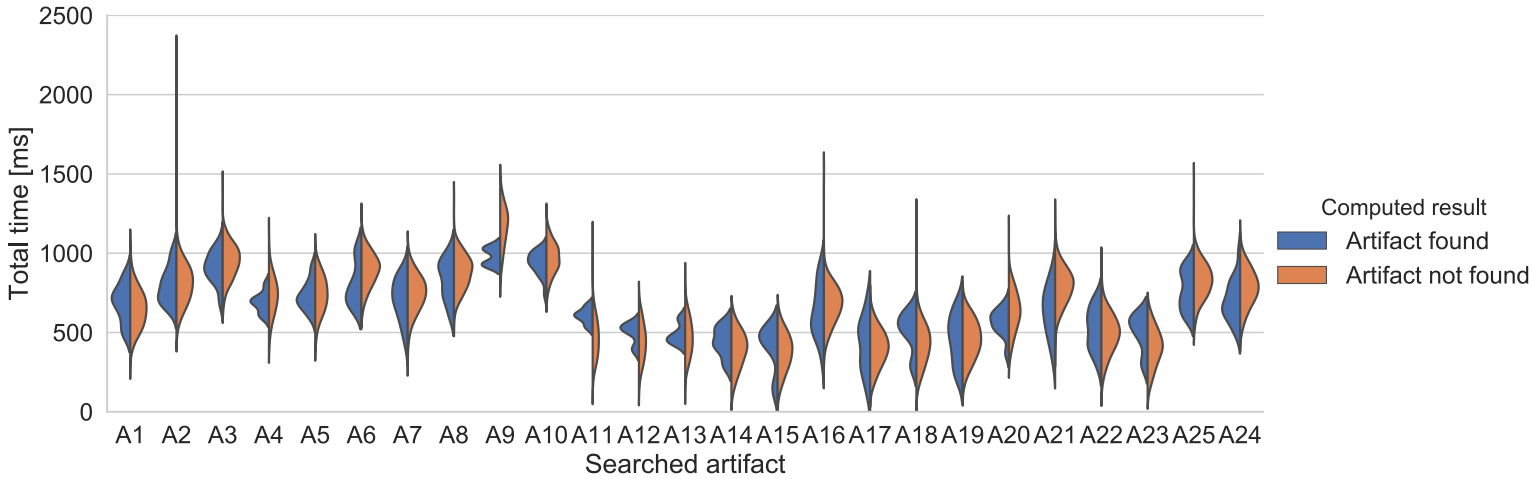
Artifact

sum measured / sum goal	A 14	A 15	A 16	A 17	A 18	A 19	A 20	A 21	A 22	A 23	A 24	A 25	Total
TP	$\frac{5}{5}$	$\frac{5}{5}$	$\frac{20}{20}$	$\frac{11}{20}$	$\frac{5}{5}$	$\frac{18}{20}$	$\frac{10}{10}$	$\frac{40}{40}$	$\frac{10}{10}$	$\frac{5}{5}$	$\frac{20}{20}$	$\frac{14}{15}$	$\frac{273}{305}$
TN	$\frac{360}{360}$	$\frac{360}{360}$	$\frac{345}{345}$	$\frac{345}{345}$	$\frac{360}{360}$	$\frac{345}{345}$	$\frac{355}{355}$	$\frac{325}{325}$	$\frac{355}{355}$	$\frac{360}{360}$	$\frac{345}{345}$	$\frac{350}{350}$	$\frac{8810}{8820}$
FP	$\frac{0}{360}$	$\frac{0}{360}$	$\frac{0}{345}$	$\frac{0}{345}$	$\frac{0}{360}$	$\frac{0}{345}$	$\frac{0}{355}$	$\frac{0}{325}$	$\frac{0}{355}$	$\frac{0}{360}$	$\frac{0}{345}$	$\frac{0}{350}$	$\frac{10}{8820}$
FN	$\frac{0}{5}$	$\frac{0}{5}$	$\frac{0}{20}$	$\frac{9}{20}$	$\frac{0}{5}$	$\frac{2}{20}$	$\frac{0}{10}$	$\frac{0}{40}$	$\frac{0}{10}$	$\frac{0}{5}$	$\frac{0}{20}$	$\frac{1}{15}$	$\frac{32}{305}$

Artifact

Results of used resources





Used Resources: Details? Factors?

First setup: Heterogeneity of artifact types; Too many confounding variables
$\Rightarrow$ Second setup

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- Eight artifact types Q 0 to Q 7, two reference images r_a, r_b
- Two different screenshots: Artifact present (s_{ap}) and absent (s_{aa})
- Each combination 1000 times
- 16000 executions of the VAD

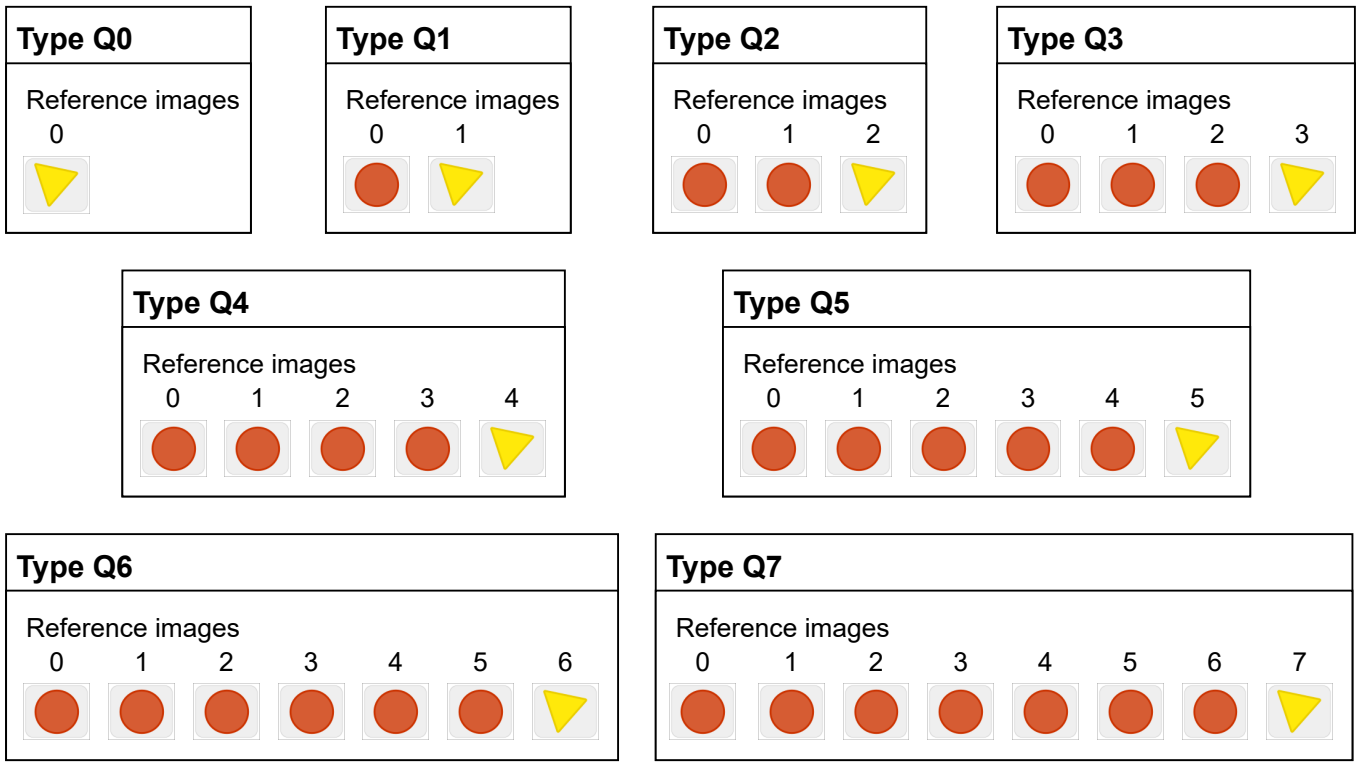

Figure: Structure of the artifact types Q0 to Q7.

Results for setup 2

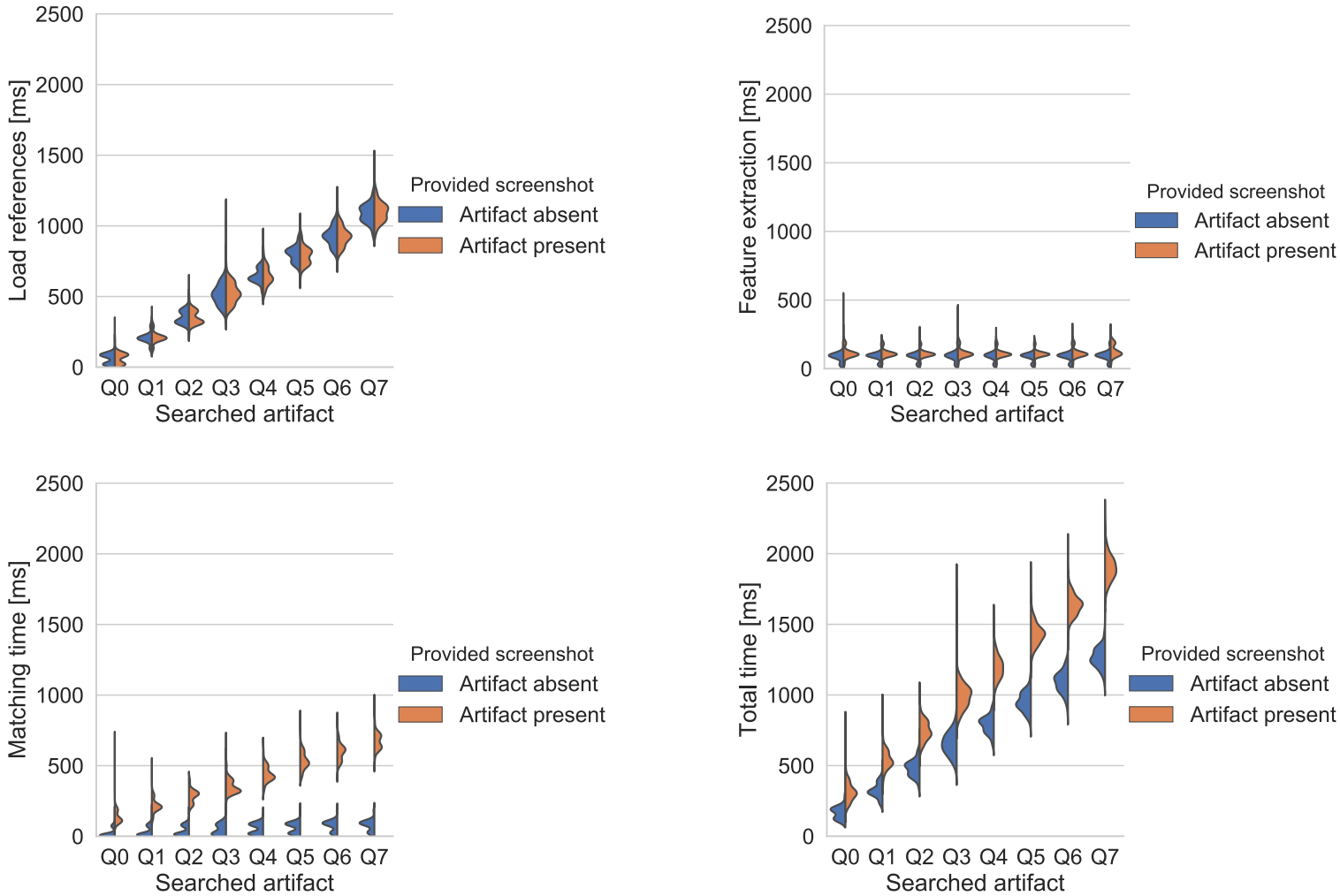

Figure: Execution time distributions for artifacts Q0 to Q7.

Other resources

Measured at random times during all executions.

- 100% CPU usage
- About 30 to 45MB RAM usage

Conclusions

- Successful implementation regarding detection
- Room for improvement for execution duration, but success for average

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Future work could include:

- Improvement of caching mechanism

Thank you for listening!

Do you have any questions, remarks?

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