AMD

RADEON
TECHNOLOGIES GROUP

AMD OpenVX open-source on GitHub

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MAY 4, 2016

AGENDA

- Design Goals
- Performance Optimization
- Graph Optimizer
- OpenCL Code Generator
- Prototyping Tools (RunVX and GDF)
- Examples

AMD OpenVX Design Goals

AMD

- High performance on x86 CPU (SIMD) and GPU (OpenCL)
- Open Source
- Microsoft Windows, Linux, Apple Mac
- Provide tools for easy testing and prototyping
- Full Khronos Conformance
- OpenCV interop

PERFORMANCE OPTIMIZED FOR X86 CPU AND GPU

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- 200+ kernels hand-optimized for x86 with SIMD assembly instructions
- 200+ kernels hand-optimized with OpenCL for AMD GPUs
- OpenCL code generator for functions such as convolutions

AMD GRAPH OPTIMIZER

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- The entire graph is analyzed for optimization opportunities prior to graph execution, such as
  - Merging of kernels to save bandwidth
  - Elimination of unused code
  - Prefetching of data into high speed local memory in the GPU
  - Optimum kernel selection

- Example with skin tone detection follows

EXAMPLE: SKIN TONE DETECTION

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Kovac's original model:

(R,G,B) is classified as skin if:

R > 95 and G > 40 and B > 20 and

max{R,G,B} – min{R,G,B} > 15 and

|R-G| > 15 and R > G and R > B

Kovac's simplified model: (R,G,B) is classified as skin if:

R > 95 and

G > 40 and

B > 20 and

R–G > 15 and

R–B > 0

SKIN TONE DETECTION GRAPH

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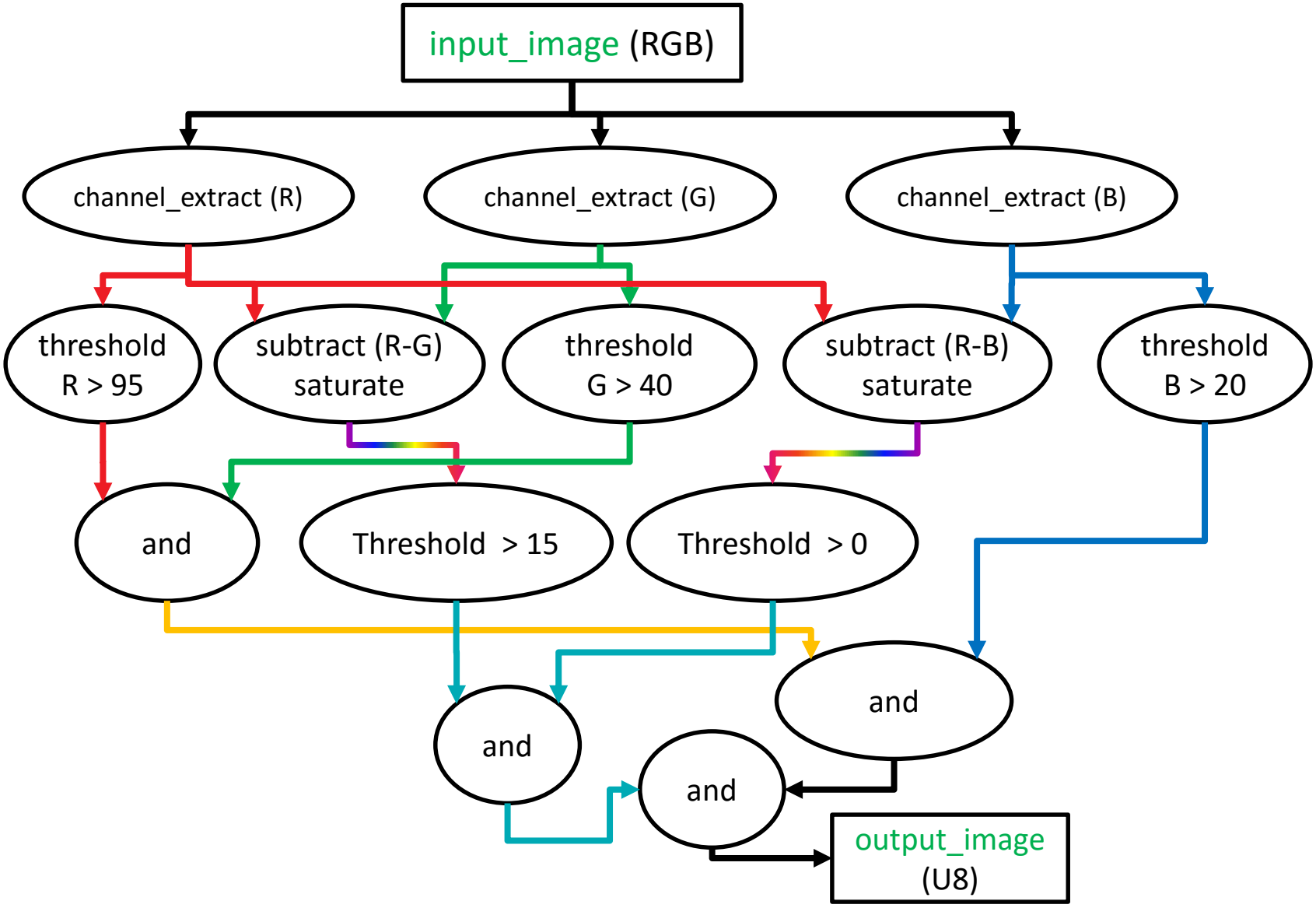

SKIN TONE DETECTION GDF

```
node channel_extract input_image !CHANNEL_R  R
node channel_extract input_image !CHANNEL_G  G
node channel_extract input_image !CHANNEL_B  B

node subtract  R  G  !SATURATE RmG
node subtract  R  B  !SATURATE RmB

node threshold  R   thr95   R95
node threshold  G   thr40   G40
node threshold  B   thr20   B20
node threshold  RmG thr15   RmG15
node threshold  RmB thr0    RmB0

node and  R95   G40   and1
node and  and1  B20   and2
node and  RmG15 RmB0  and3
node and  and2 and3   output_image
```

Color key

- gdf keyword
- OpenVX node names
- Inputs
- Outputs
- Parameters

SKIN TONE DETECTION

OPTIMIZED GRAPH

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[Optimized Graph]

```
node ChannelExtract_U8U8U8_U24_Pos0 R G B input_image
node Sub_U8_U8U8_Sat RmG R G
node Sub_U8_U8U8_Sat RmB R B
node Threshold_U1_U8_Binary R95 R thr95
node Threshold_U1_U8_Binary G40 G thr40
node Threshold_U1_U8_Binary B20 B thr20
node Threshold_U1_U8_Binary RmG15 RmG thr15
node Threshold_U1_U8_Binary RmB0 RmB thr0
node And_U1_U1U1 and1 R95 G40
node And_U1_U1U1 and2 and1 B20
node And_U1_U1U1 and3 RmG15 RmB0
node And_U8_U1U1 output_image and2 and3
```

```
Optimized Color key

gdf keyword
Optimized node names
Inputs
Outputs
Parameters
```

- When this is executed on the GPU, all these nodes are fused into one OpenCL kernel, eliminating 90%+ of the bandwidth

[Merged Graph]

```
node merge_on_gpu output_image input_image
```

(note: not all details shown)

PLUG-IN YOUR OWN OpenCL CODE GENERATOR

AMD

- Do you have an algorithm that maps well onto GPUs?
- Create your own OpenVX kernel by just providing an OpenCL code generator

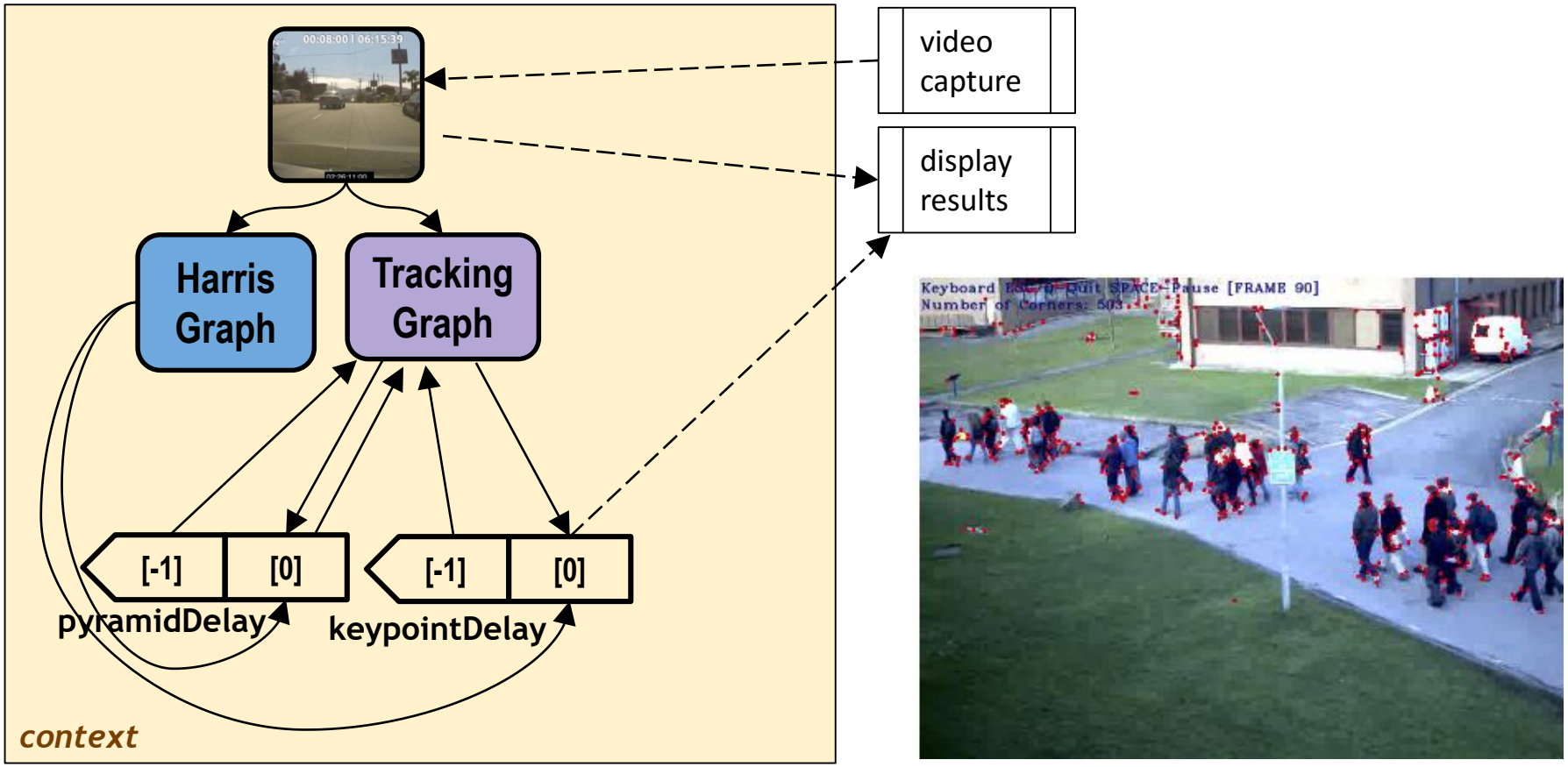
```
vx_status VX_CALLBACK user_kernel_opencl_codegen (
    vx_node node,
    char opencl_kernel_function_name[64],
    std::string& opencl_kernel_code,
    std::string& opencl_build_options,
    vx_uint32& opencl_work_dim,
    vx_size opencl_global_work[],
    vx_size opencl_local_work[],
    …
)
```

- The remainder is managed by the AMD OpenVX framework

GRAPH DESCRIPTION FORMAT FOR QUICK PROTOTYPING

AMD

You can quickly prototype complex application scenarios using few lines of text…



GRAPH DESCRIPTION FORMAT FOR QUICK PROTOTYPING

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Data Objects and I/O

```
data input = image:768,576,RGB2
read input PETS09-S1-L1-View001.avi
view input feature-tracker-window

data iyuv = image-virtual:0,0,IYUV
...
```

For the full GDF:

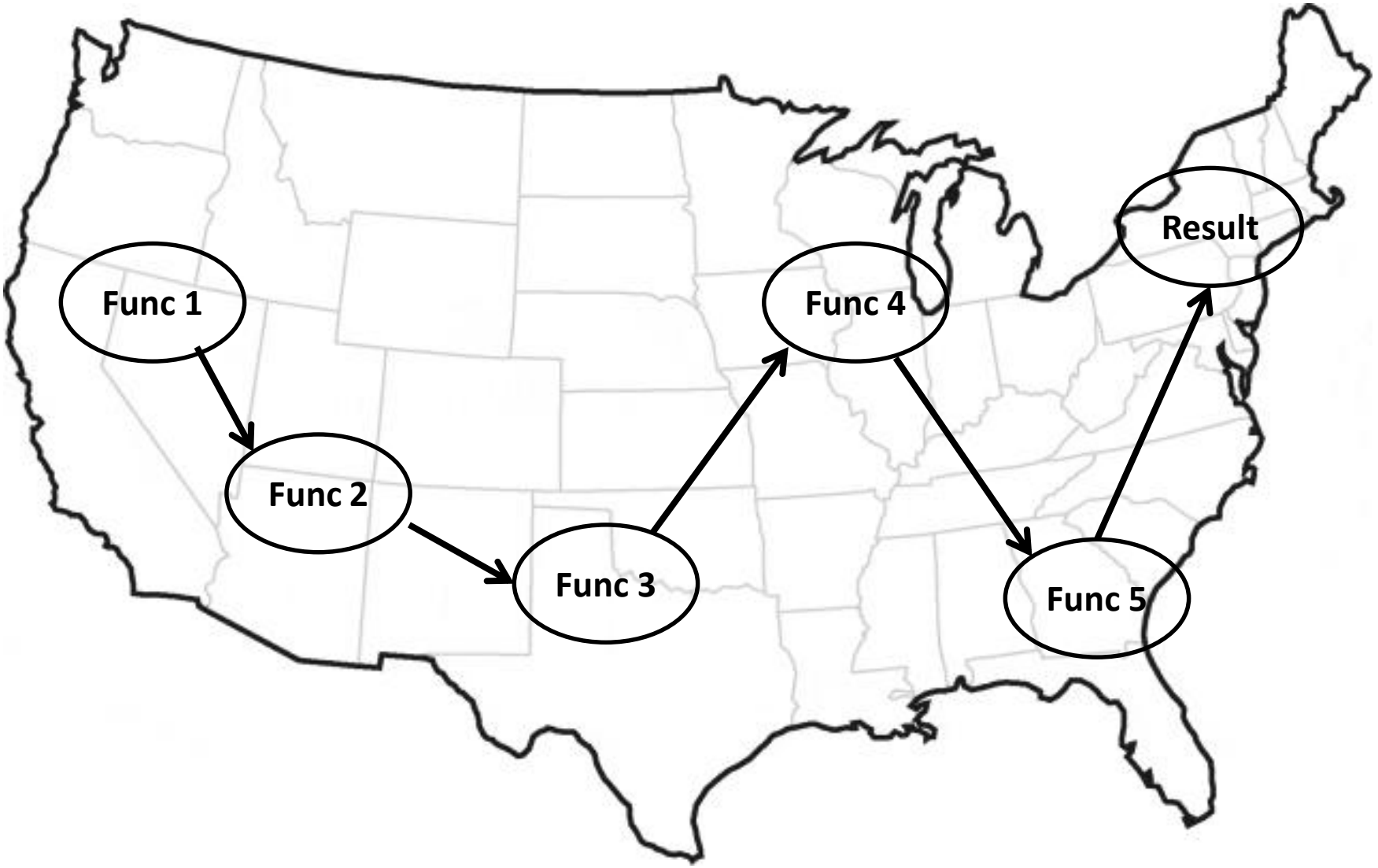
visit amdovx-core/runvx on GitHub

Tracking Graph

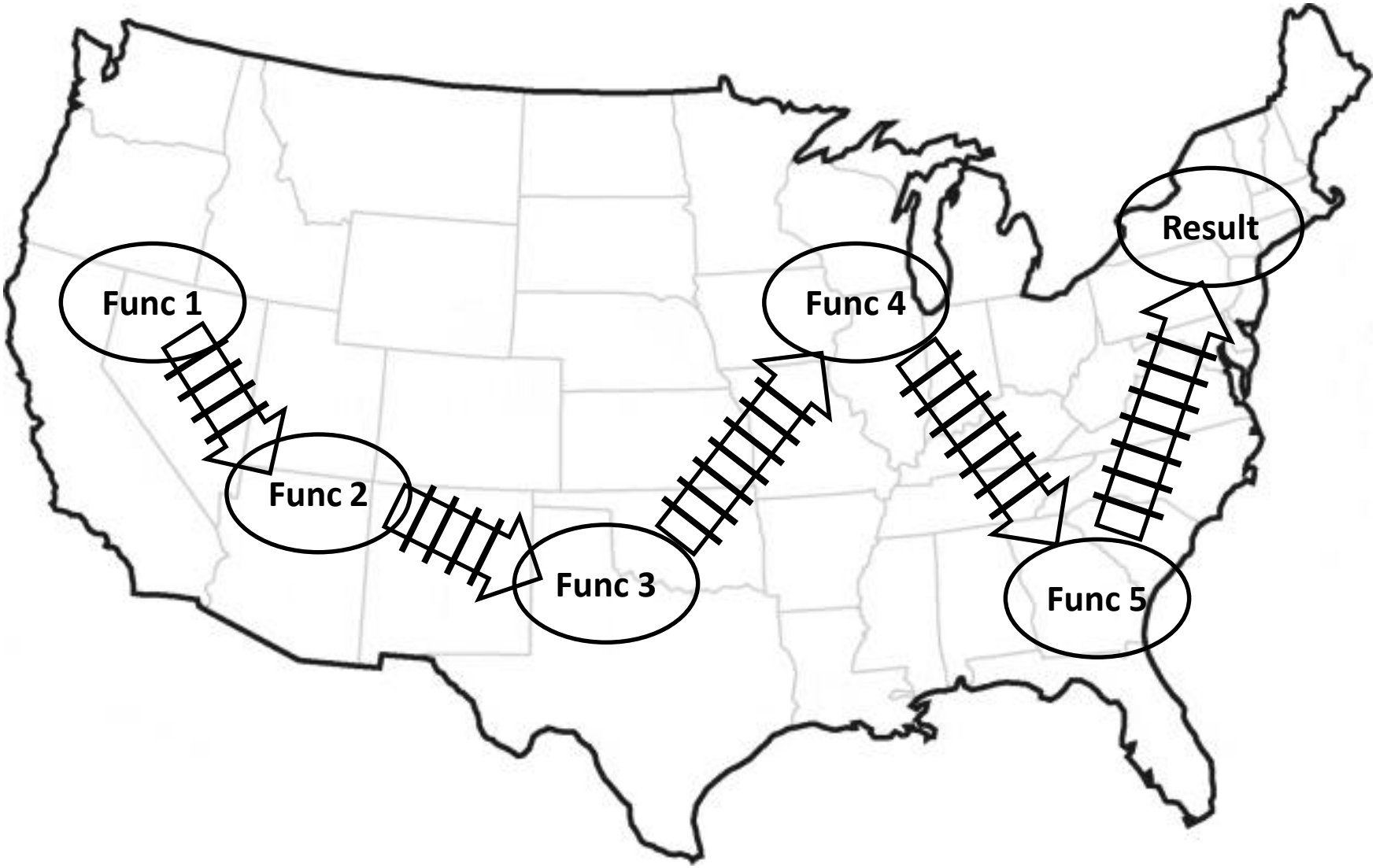
```
node org.khronos.openvx.color_convert      input  iyuv
node org.khronos.openvx.channel_extract    iyuv !CHANNEL_Y luma
node org.khronos.openvx.gaussian_pyramid   luma delayPyr[0]
node org.khronos.openvx.optical_flow_pyr_lk delayPyr[-1] delayPyr[0] \
                                            delayArr[-1] delayArr[-1] delayArr[0] \
                                            termination epsilon num_iterations \
                                            use_initial_estimate window_dimension
```

Summary: The OpenVX Advantage

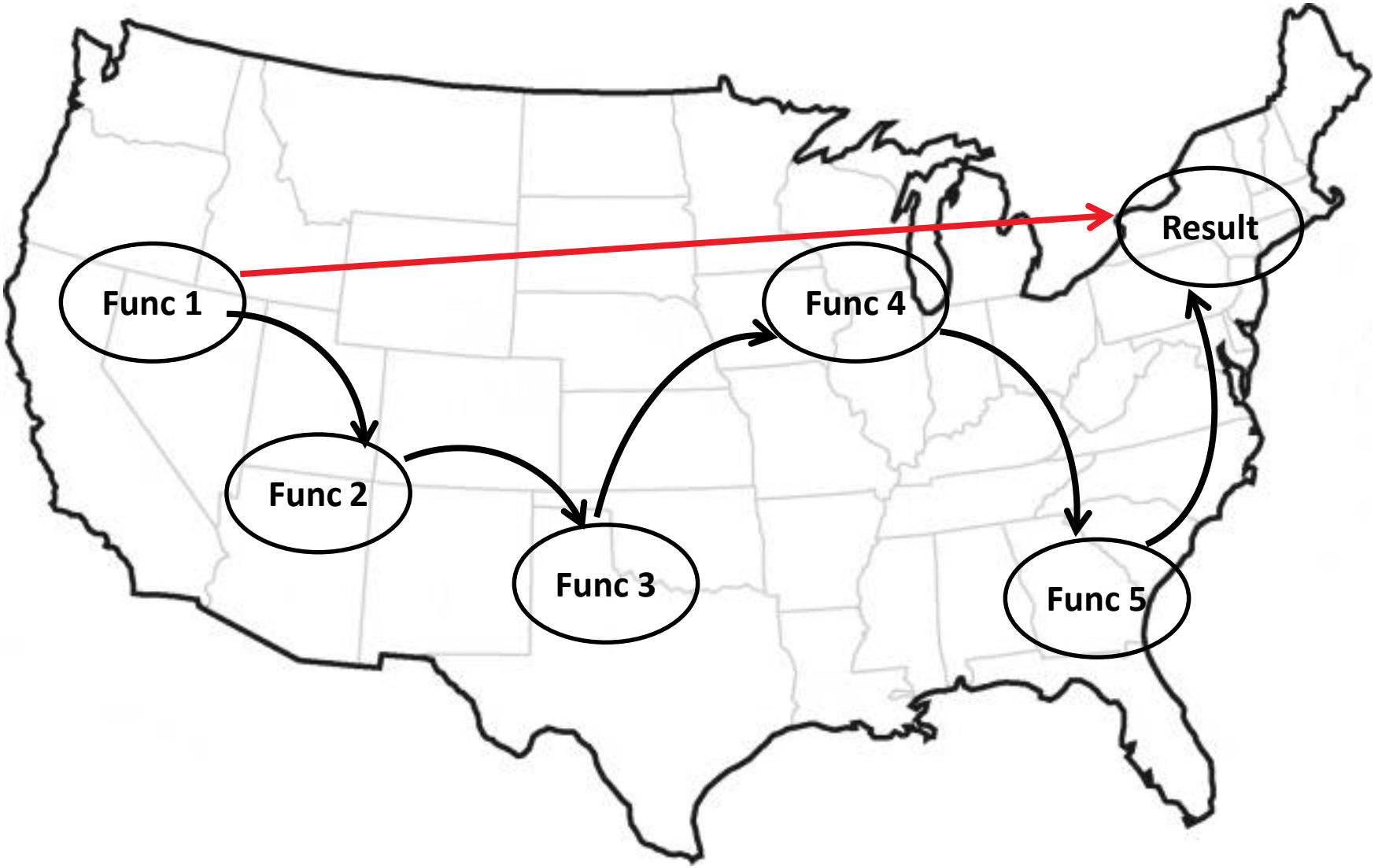
AMD



The OpenVX Advantage



The OpenVX Advantage

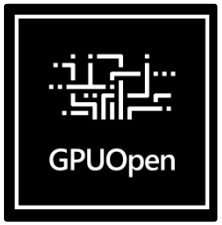


Summary

AMD

- Download and use the code
  - Link at the AMD GPUOpen web site

  http://gpuopen.com/compute-product/amd-openvx/



- Join github, then go to these links:

https://github.com/GPUOpen-ProfessionalCompute-Libraries/amdovx-core

https://github.com/GPUOpen-ProfessionalCompute-Libraries/amdovx-modules

- Support: Report any problems on the github “issues” tab

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