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ECE 4930-004

**HW3**

***Part 1: Installing FlipIt***

```
[epaulz@login001 matmul]$ ./long
Fault injector seed: 533
Starting faulty computation.

/*********************************Start**************************************/

Successfully injected Integer Data error!!
Rank: 0
Total # faults injected: 1
Bit position is: 27
Index of the fault site: 240
Fault site probability: 1.000000e-08
Chosen random probability is: 9.794167e-09
Attempts since last injection: 8113437

/*********************************End**************************************/
Number of incorrect elements: 1
[epaulz@login001 matmul]$
```

***Part 2: Compile HPCCG***

```
[epaulz@login001 HPCCG-1.0]$ mpirun -n 8 ./test_HPCCG 32 32 32
Initial Residual = 1944.57
Iteration = 15   Residual = 18.1609
Iteration = 30   Residual = 0.043237
Iteration = 45   Residual = 0.000160905
Iteration = 60   Residual = 7.41837e-07
Iteration = 75   Residual = 3.07385e-09
Iteration = 90   Residual = 1.42189e-11
Iteration = 105   Residual = 5.99938e-14
Iteration = 120   Residual = 2.62093e-16
Iteration = 135   Residual = 5.8031e-19
Iteration = 149   Residual = 1.20172e-21
Mini-Application Name: hpccg
Mini-Application Version: 1.0
Parallelism:
  Number of MPI ranks: 8
  OpenMP not enabled:
Dimensions:
  nx: 32
  ny: 32
  nz: 32
Number of iterations: : 149
Final residual: : 1.20172e-21
********** Performance Summary (times in sec) ***********:
Time Summary:
  Total   : 0.849358
  DDOT    : 0.12653
  WAXPBY  : 0.0734024
  SPARSEMV: 0.644499
FLOPS Summary:
  Total   : 2.49981e+09
  DDOT    : 1.56238e+08
  WAXPBY  : 2.34357e+08
  SPARSEMV: 2.10921e+09
MFLOPS Summary:
  Total   : 2943.17
  DDOT    : 1234.79
  WAXPBY  : 3192.77
  SPARSEMV: 3272.63
DDOT Timing Variations:
  Min DDOT MPI_Allreduce time: 0.0127676
  Max DDOT MPI_Allreduce time: 0.0651364
  Avg DDOT MPI_Allreduce time: 0.0318385
SPARSEMV OVERHEADS:
  SPARSEMV MFLOPS W OVERHEAD: 3121.47
  SPARSEMV PARALLEL OVERHEAD Time: 0.0312111
  SPARSEMV PARALLEL OVERHEAD Pct: 4.61901
  SPARSEMV PARALLEL OVERHEAD Setup Time: 0.0270848
  SPARSEMV PARALLEL OVERHEAD Setup Pct: 4.00835
  SPARSEMV PARALLEL OVERHEAD Bdry Exch Time: 0.00412631
  SPARSEMV PARALLEL OVERHEAD Bdry Exch Pct: 0.610663
[epaulz@login001 HPCCG-1.0]$
```

***Part 3: Instrument HPCCG for Fault Injection***

```
[epaulz@login001 HPCCG-1.0]$ mpirun -n 8 ./test_HPCCG 32 32 32 --stateFile
/home/epaulz/FlipIt//.HPCCG --numberFaulty 1 --faulty 2 29634
Fault injector seed: 233
Initial Residual = 1944.57

/*******************************Start*************************************/

Successfully injected 64-bit IEEE Float Data error!!
Rank: 2
Total # faults injected: 1
```

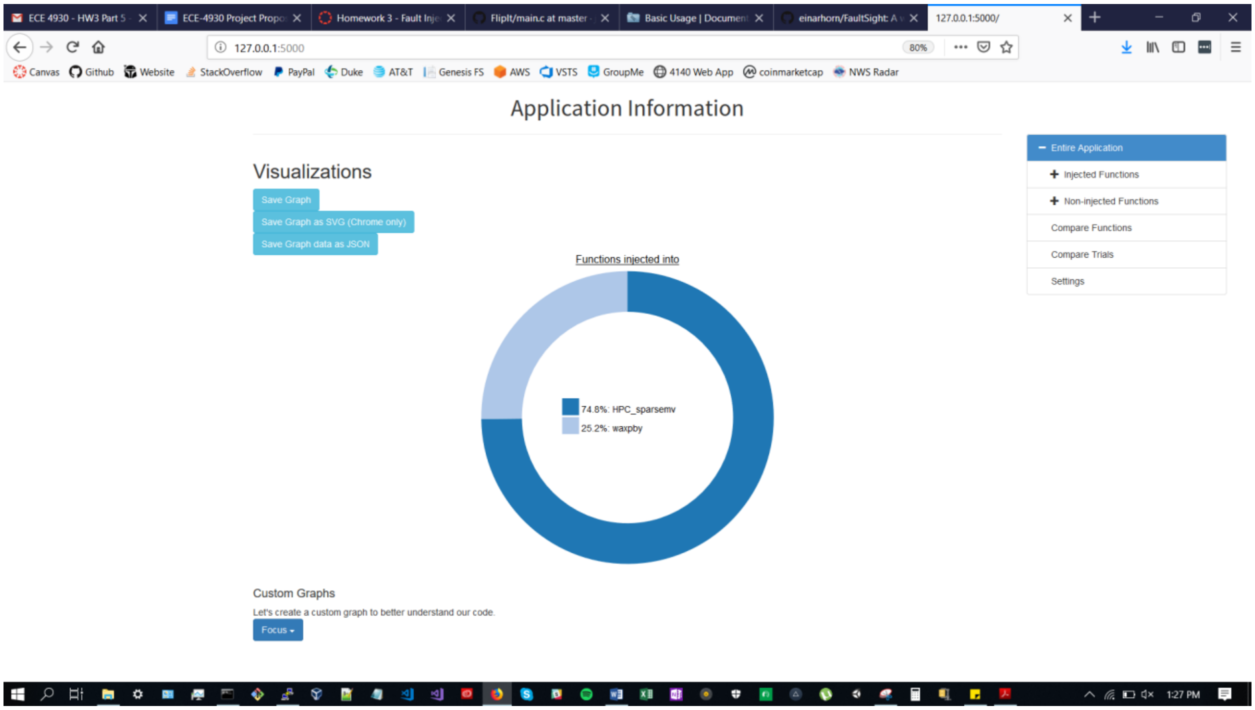
```
Bit position is: 47
Index of the fault site: 84509
Fault site probability: 1.000000e-08
Chosen random probability is: 4.862908e-09
Attempts since last injection: 292195571

/********************************End**************************************/
Iteration = 45   Residual = 0.000160905
Mini-Application Name: hpccg
Mini-Application Version: 1.0
Parallelism:
  Number of MPI ranks: 8
  OpenMP not enabled:
Dimensions:
  nx: 32
  ny: 32
  nz: 32
Number of iterations: : 85
Final residual: : 8.73231e-11
********** Performance Summary (times in sec) ***********:
Time Summary:
  Total   : 28.686
  DDOT    : 12.4724
  WAXPBY  : 1.50439
  SPARSEMV: 14.6818
FLOPS Summary:
  Total   : 1.42606e+09
  DDOT    : 8.9129e+07
  WAXPBY  : 1.33693e+08
  SPARSEMV: 1.20324e+09
MFLOPS Summary:
  Total   : 49.7129
  DDOT    : 7.14612
  WAXPBY  : 88.8686
  SPARSEMV: 81.9546
DDOT Timing Variations:
  Min DDOT MPI_Allreduce time: 0.0298896
  Max DDOT MPI_Allreduce time: 11.6615
  Avg DDOT MPI_Allreduce time: 10.0234
SPARSEMV OVERHEADS:
  SPARSEMV MFLOPS W OVERHEAD: 78.7424
  SPARSEMV PARALLEL OVERHEAD Time: 0.598935
  SPARSEMV PARALLEL OVERHEAD Pct: 3.91955
  SPARSEMV PARALLEL OVERHEAD Setup Time: 0.571971
  SPARSEMV PARALLEL OVERHEAD Setup Pct: 3.74309
  SPARSEMV PARALLEL OVERHEAD Bdry Exch Time: 0.0269642
  SPARSEMV PARALLEL OVERHEAD Bdry Exch Pct: 0.176459
[epaulz@login001 HPCCG-1.0]$
```

### *Part 4: Conduct a Fault Injection Campaign*

--- done ---

### *Part 5: Installing FaultSight*



Application Information

Visualizations

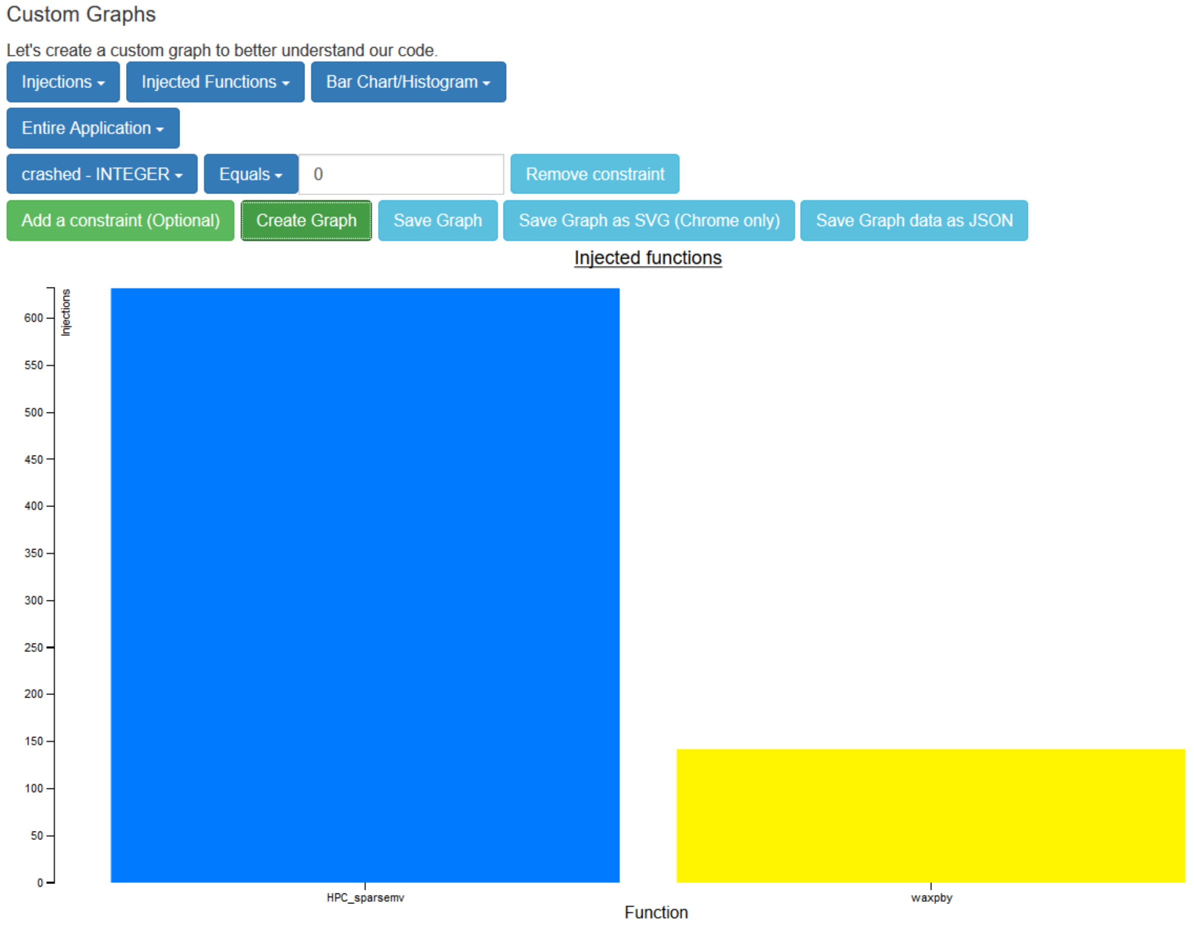
Custom Graphs

Let's create a custom graph to better understand our code.

### *Part 6: Fault Injection Analysis with FaultSight*

- What are the functions that faults are injected into?
  - HPC_sparsemv
  - waxpby
- What is the percentage of fault injection trials that have detection?
  - 0%
- What are the bit locations that have detection?
  - 12-23
  - 24-35
  - 36-47
  - 48-63
- What is the percent of trials that segfaulted?
  - Can’t figure out how to see segfaults in FaultSight.
- What are the bit locations that generate a segfault? Why do you think these bits cause a segfault?
  - Same as above.
- What are the bit locations in ddot where we inject faults?

    - Empty dataset returned?
- What line of code suffers the most injections?  Why do you think this line suffers the most injections?
    - HPC_sparsemv
        - Line 74
    - waxpby
        - Line 57
- Use the custom constraints to generate two plots that you find interesting.  Explain why you find these plots interesting and provide an analysis of what the plots show.



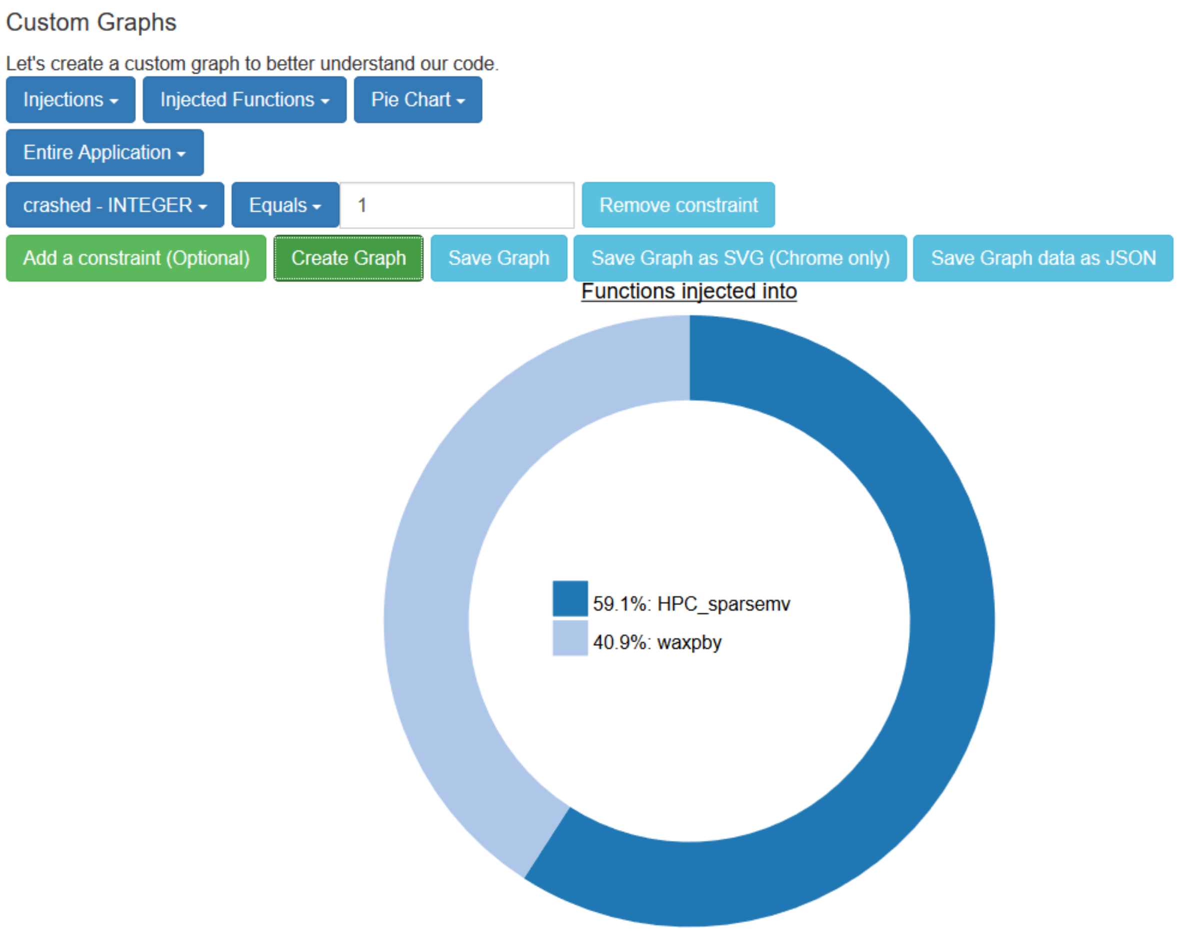
Custom Graphs

Let's create a custom graph to better understand our code.

Injections ▾ | Injected Functions ▾ | Bar Chart/Histogram ▾

Entire Application ▾

crashed - INTEGER ▾ | Equals ▾ | 0



Custom Graphs

Let's create a custom graph to better understand our code.

These graphs are interesting because they show the difference between which trials crashed and which ones did not among the injections in these two functions.

Based on the above analysis does anything stand out to you? Finally, estimate how, if at all, the added error detector could improve the application's reliability.

Not really.

It could improve reliability by showing the user or developer where they can make improvements. The GUI functionality of FaultSight is helpful for visualizing the data.