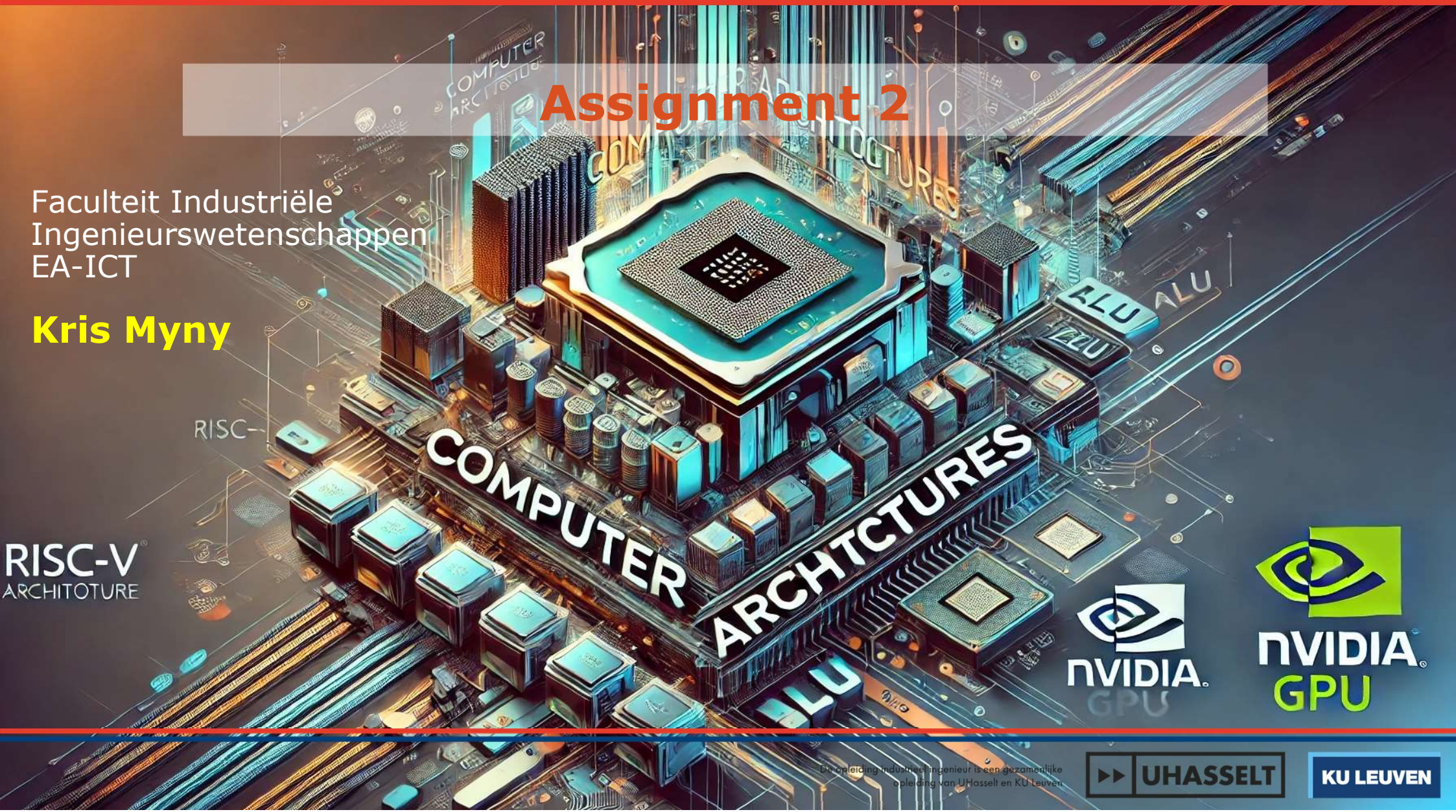
Assignment 2

Faculteit Industriële Ingenieurswetenschappen
EA-ICT

Kris Myny



Assignment 2

- You have to write assember code for three different programs.
- Use sufficient # to explain the program.
- Generate a small report (*Word or Latex*) showing your code and output for the assigment,
- By when? Wednesday **October 23, 2024**
- Upload on Toledo!

- Which programs?
  1. String reverse
  2. Calculate median ➔ cycle count via Ripes
  3. n'th element Fibonacci calculation ➔ cycle count via Ripes
- Ripes ➔ see last slides

String reverse

- Simple warming up exercise ☺
- Let's load a string and reverse it.
  Save the reverse string!
- First calculate the length of the string, don't define this in data.

```
.data
lab:
.byte 'h'
.byte 'e'
.byte 'l'
.byte 'l'
.byte 'o'
.byte 32
.byte ‘c'
.byte 'o'
.byte ‘m'
.byte ‘a'
.byte ‘r'
.byte '!'
.byte 0
```

- First plot original string, followed by reversed string.

Median

- On the next slide, you can copy the array and array lengths for this lab.
- First, you perform the bubblesort algorithm to sort the array.
- Then, you calculate the median
  - In case of odd number of elements → middle element
  - In case of even number of elements → average of both middle elements (of course with integers and rounded numbers)
- Print the original array, the sorted array and the median. Make even and odd array sizes (min 7 elements); Add this code to the report.
- Remove printing of original array. Keep the printing of the median (for debugging) and count the cycles via Ripes.

```
void sort(int v[], size_t n)
{
  size_t i, j;
  for (i = n-2; i >= 0; i--){
      for (j = 0; j <= i; j++){
          if (v[j] > v[j+1]){
              swap(v, j);
           }
      }
  }
}
```

To evaluate whether a number is even:
Value = (n+1)%2
You can use the rem(ainder) instruction
rem rd, rs, rs
If rd = 1 ➔ even; if rd = 0 ➔ odd

Students that improve the cycle count can get a higher score.
This can be done by optimizing the code, or by using an improved sorting algorithm. Obviously, you need to compare with the original Bubblesort algorithm.
Explain the amendments in your report.

Arrays

- length: .word 10
- array: .word 2, 4, 8, 5, 1, 9, 2, 8, 9, 25

- length: .word 11
- array: .word 2, 4, 8, 5, 1, 9, 2, 8, 9, 25, 0

- length: .word 100
- array: .word 1138, 533, 1465, 389, 492, 878, 1444, 120, 1127, 1383, 793, 1499, 395, 790, 927, 1375, 936, 306, 1459, 90, 75, 582, 259, 943, 1203, 1305, 596, 143, 581, 781, 1383, 1285, 191, 329, 980, 972, 74, 1203, 1224, 17, 48, 767, 229, 1291, 1099, 745, 679, 596, 1367, 738, 767, 1458, 863, 405, 136, 513, 1472, 1249, 589, 178, 1083, 1292, 1134, 1061, 1125, 173, 47, 127, 396, 1327, 1075, 499, 1496, 732, 1286, 294, 114, 1098, 872, 11, 1447, 125, 931, 1231, 874, 400, 1021, 1206, 1176, 954, 1349, 1358, 1298, 307, 709, 1209, 8, 1012, 866, 1261

- length: .word 101
- array: .word 1036, 783, 710, 939, 21, 332, 675, 1398, 1337, 28, 633, 1317, 863, 873, 1094, 886, 1171, 393, 142, 111, 638, 919, 211, 1355, 998, 1131, 821, 930, 195, 276, 704, 330, 337, 160, 133, 1199, 1250, 471, 500, 107, 1466, 774, 644, 1198, 1, 668, 45, 370, 531, 440, 928, 989, 1191, 1310, 13, 1323, 254, 1168, 853, 77, 855, 831, 969, 1435, 716, 861, 239, 1239, 644, 304, 909, 1271, 523, 1360, 183, 917, 1094, 479, 1084, 765, 74, 1438, 1021, 1100, 1494, 600, 1401, 560, 217, 1422, 1383, 505, 1371, 549, 766, 1396, 471, 14, 132, 1082, 400

Fibonacci

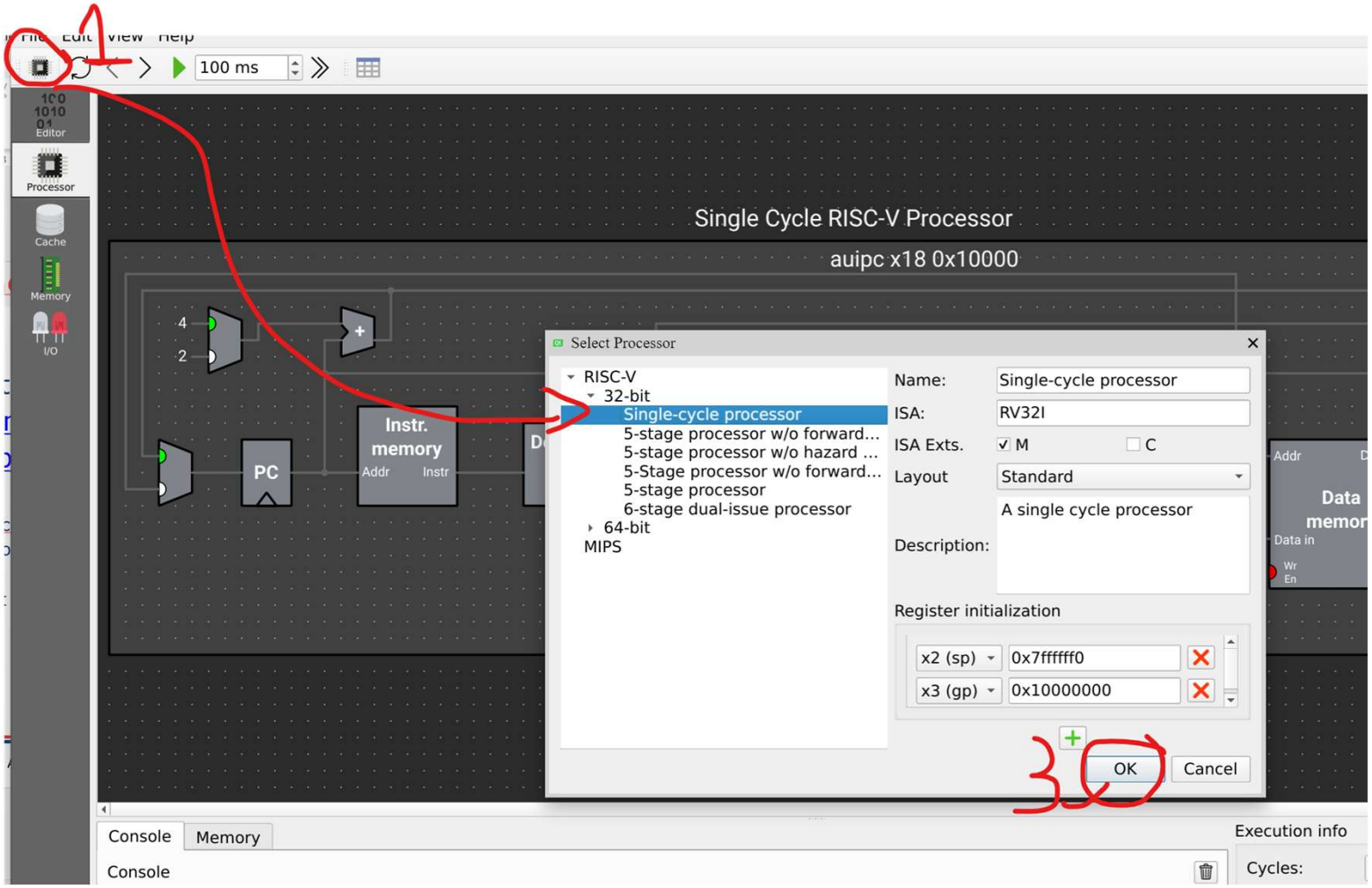
- Search google what the Fibonacci sequence is, starting from 0 .. 1 ..
- Define a variable for the n^{th} element
- You can make this recursive or non-recursive
- Print only the result (final value)

Create a graph via data obtained in Ripes.
X-axis n^{th} element (from 1-15)
Y-axis cycle count (taken from Ripes)
Improvements towards a better cycle count get a higher score.
Add this graph in the report, including some explanations,

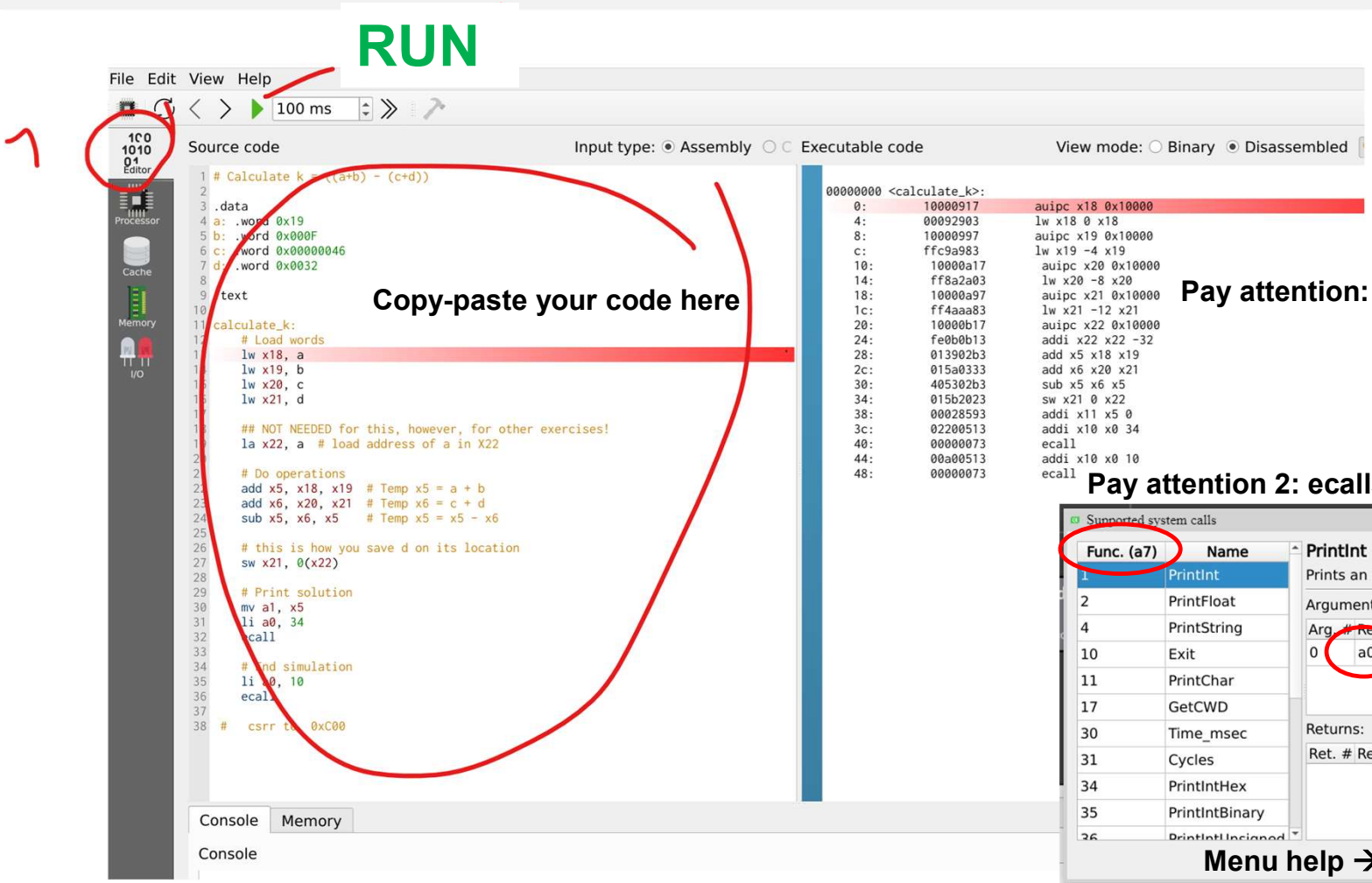
Ripes

- Visual simulator of RISC-V
- https://ripes.me/
- https://github.com/mortbopet/Ripes
- Procedure
  - Define the single cycle processor
  - Load your code from Visual Studio (Venus)
  - Run the code
  - Take a screenshot of the cycle number

Ripes - Define the single cycle processor

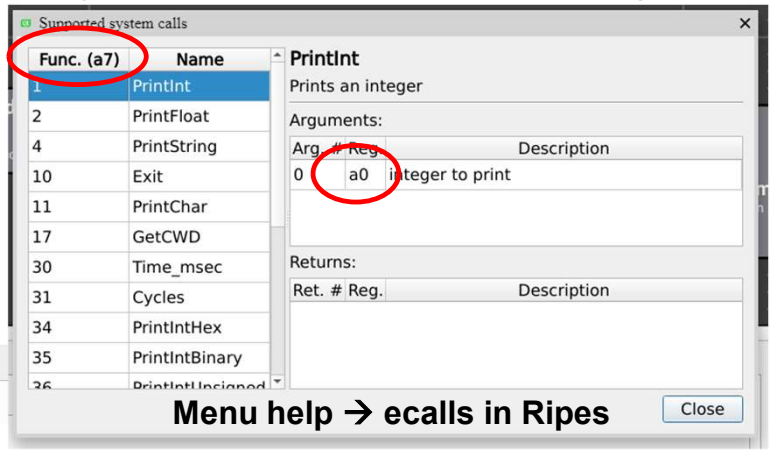


Ripes - Load your code from Visual Studio (Venus)



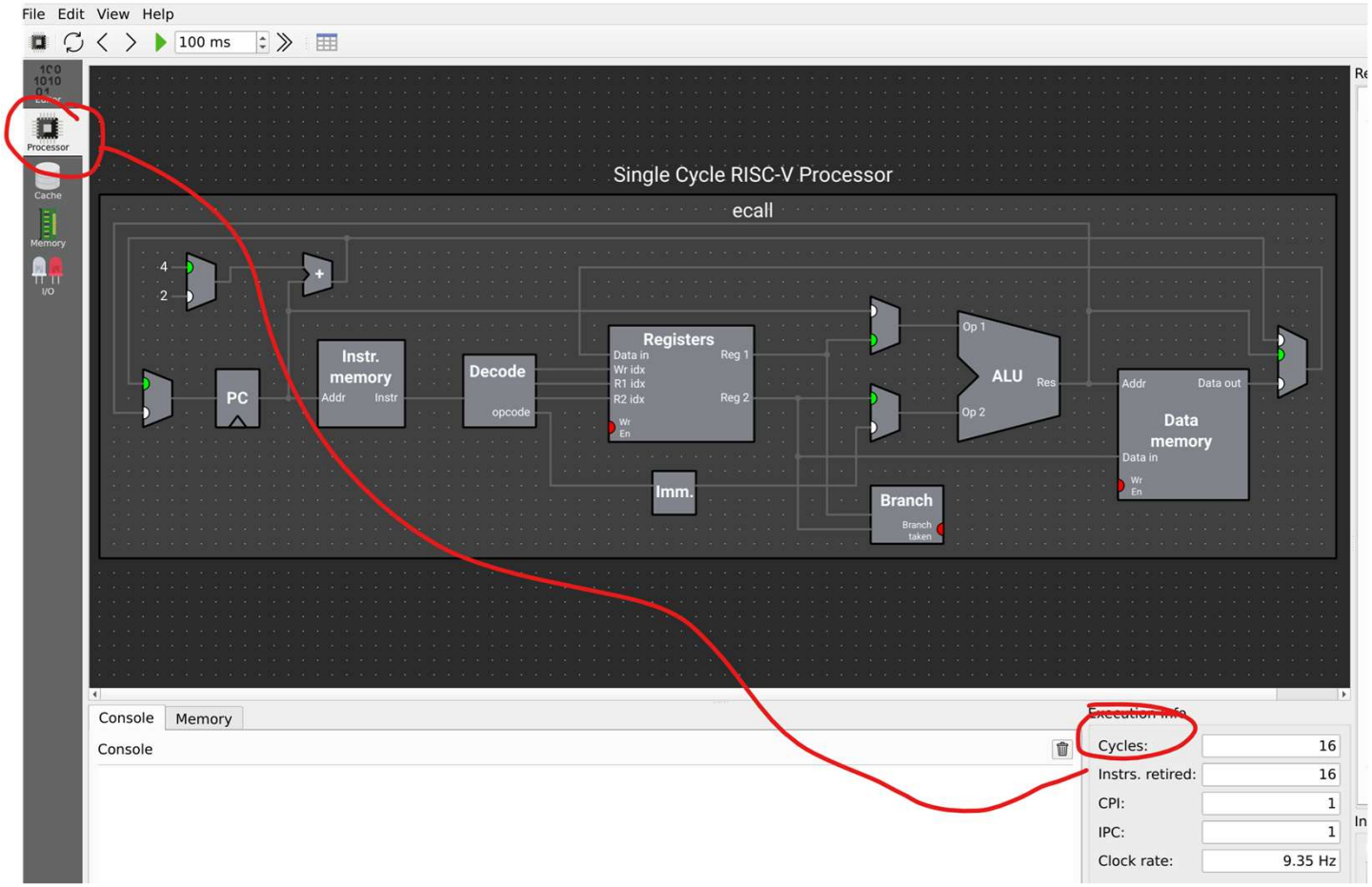
Pay attention: ripes does not support .byte

Pay attention 2: ecalls are different: reg a7 and a0



Menu help → ecalls in Ripes

Ripes - Take a screenshot of the cycle number



This screenshot

Cycles:	16
Instrs. retired:	16
CPI:	1
IPC:	1
Clock rate:	9.35 Hz