Laboratoire d'Annecy de Physique des Particules

What about Branching ?

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ESCAPE
cta cherenkov telescope array
cnrs
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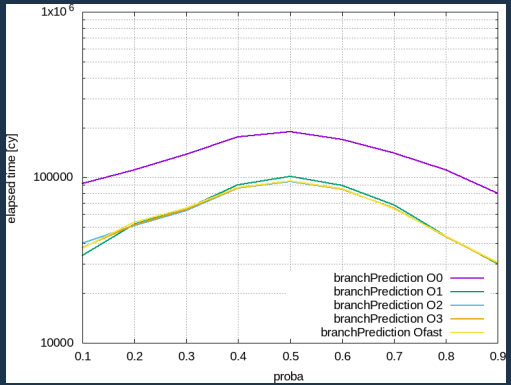
Kernel with branching

$$z_i = \begin{cases} x_i & \alpha_i < p \\ y_i & \alpha_i \geq p \end{cases}, \quad x_i, y_i \in \mathbb{R}, \quad p \in [0,1], \quad \alpha_i \in U(0,1), \quad i \in 1, N$$

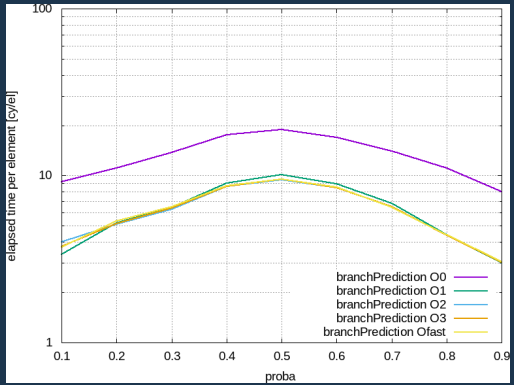
```
void dummyCopy(float* tabResult, const float * tabX, const float* tabY,
»       »       const float * tabProba, long unsigned int nbElement, float proba)
{
»       for(long unsigned int i(0lu); i < nbElement; ++i){
»       »       if(tabProba[i] < proba){
»       »       »       tabResult[i] = tabX[i];
»       »       }else{
»       »       »       tabResult[i] = tabY[i];
»       »       }
»       }
}
```

Branching probability : performances

Total Elapsed Time (cy)



Elapsed Time per element (cy/el)



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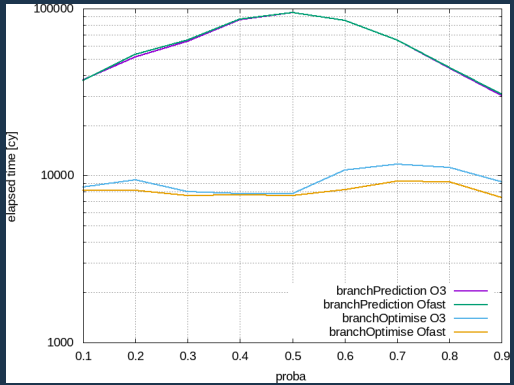
```

Change **if** into computing :

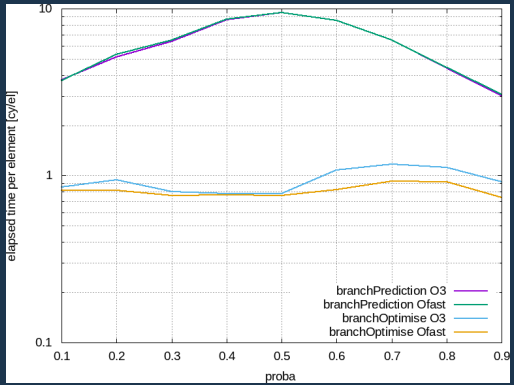
```
void dummyCopy(float* tabResult, const float * tabX, const float* tabY,
»       »       const float * tabProba, long unsigned int nbElement, float proba)
{
»       for(long unsigned int i(0lu); i < nbElement; ++i){
»       »       float cond(tabProba[i] < proba);
»       »       tabResult[i] = tabX[i]*cond + (1.0f - cond)*tabY[i];
»       }
}
```

Branching probability : optimisation

Total Elapsed Time (cy)



Elapsed Time per element (cy/el)



Computing Paradox

Version with **if** :

- **condition** : $\alpha_i < p$
- **if** : 3 cy
- $=$: equal operator

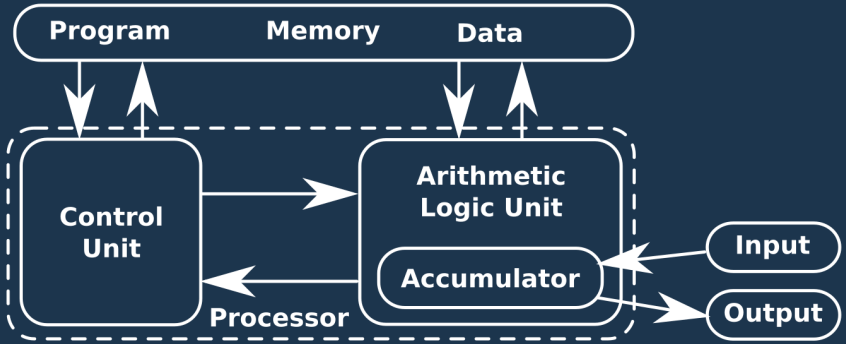
Specific computing : 3 cy

Version with computing :

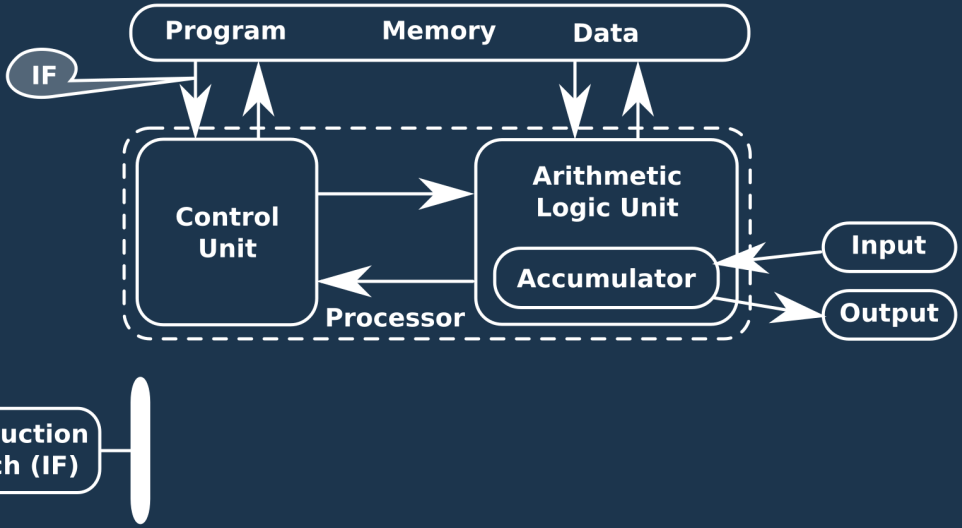
- **condition** : $\alpha_i < p$
- **2 multiplications** : 2×6 cy
- **addition + substraction** : 2×4 cy
- $=$: equal operator

Specific computing : 20 cy

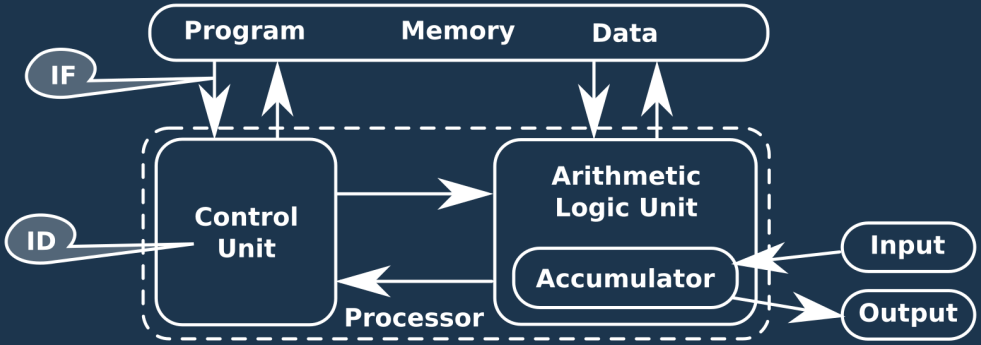
The CPU pipeline



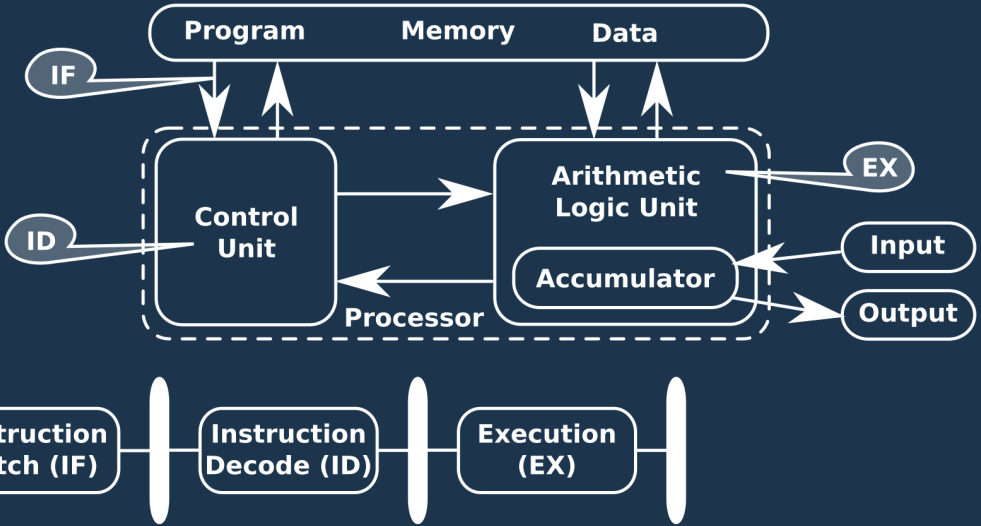
The CPU pipeline



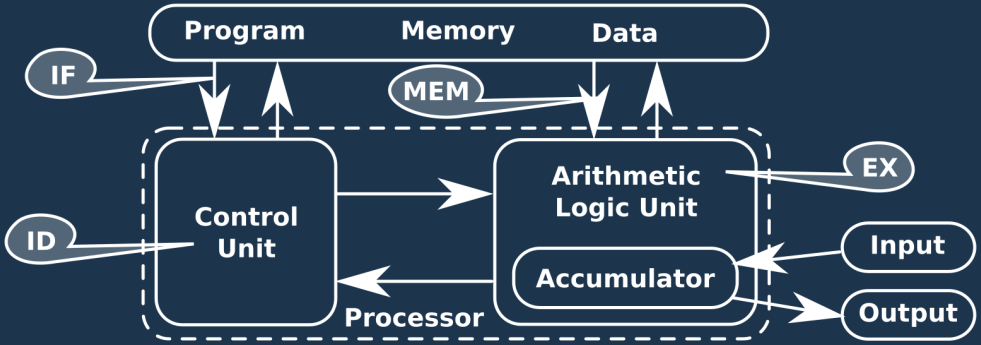
The CPU pipeline



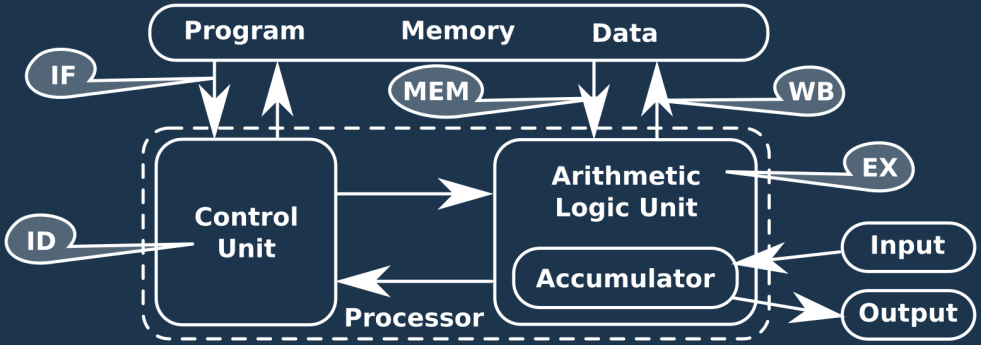
The CPU pipeline



The CPU pipeline



The CPU pipeline



The CPU pipeline

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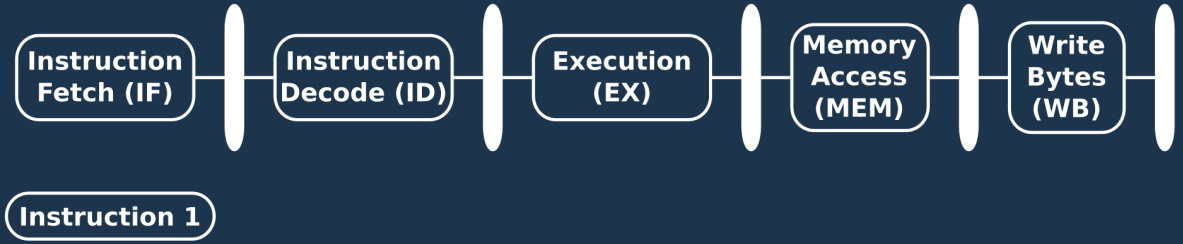
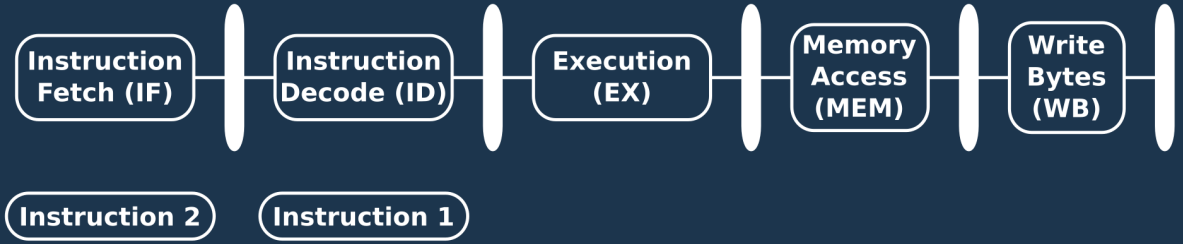
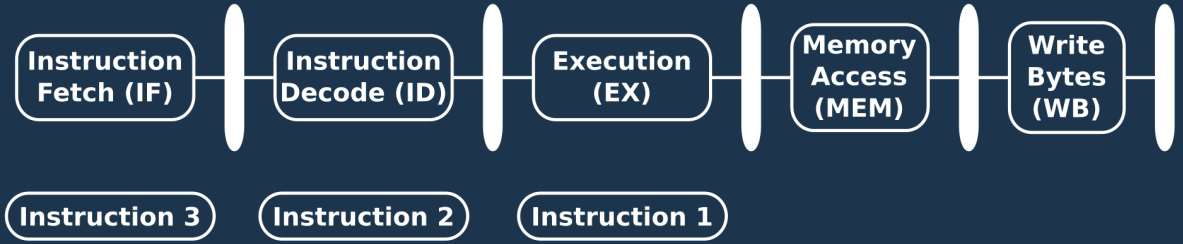


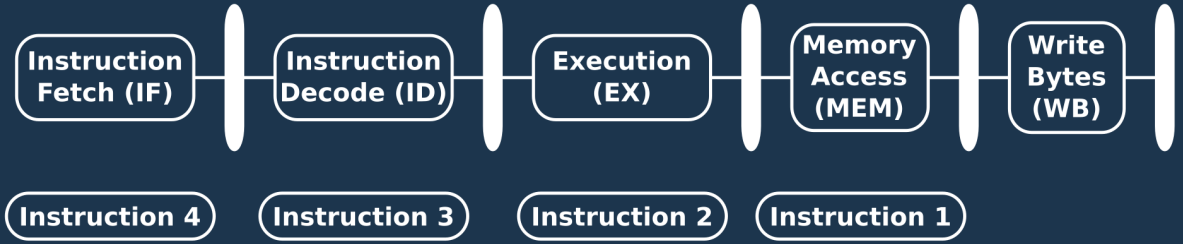
The CPU pipeline



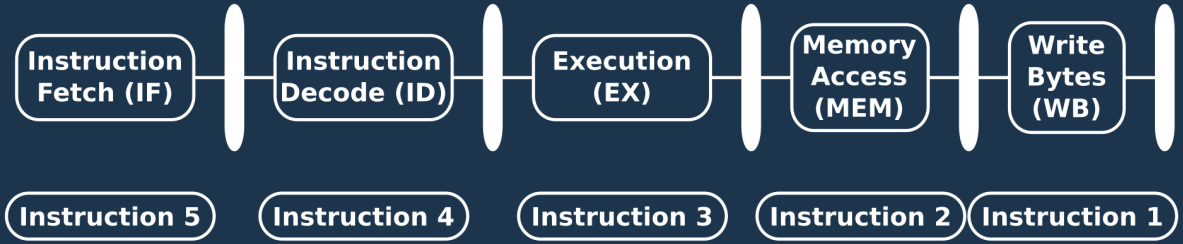
The CPU pipeline



The CPU pipeline



The CPU pipeline

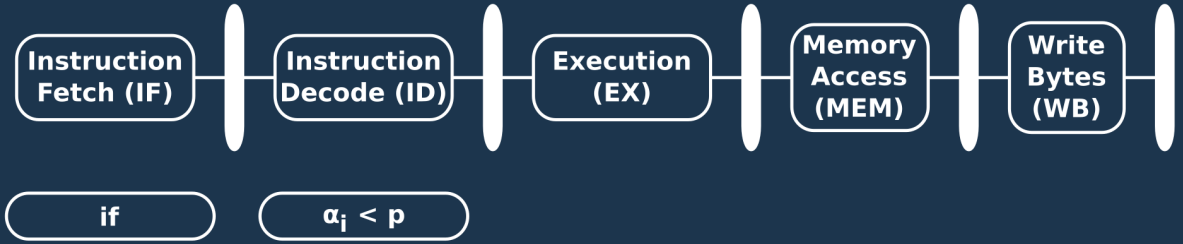


The CPU pipeline with branching

The CPU pipeline with branching

$\alpha_i < p$

The CPU pipeline with branching



The CPU pipeline with branching

$z_i = x_i$

$z_i = y_i$

?

if

$\alpha_i < p$

The CPU pipeline with branching

$z_i = x_i$

$z_i = y_i$

?

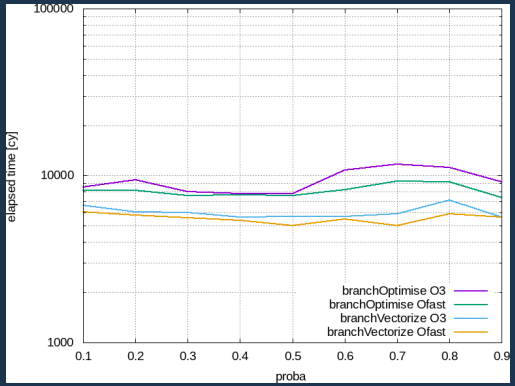
if

$\alpha_i < p$

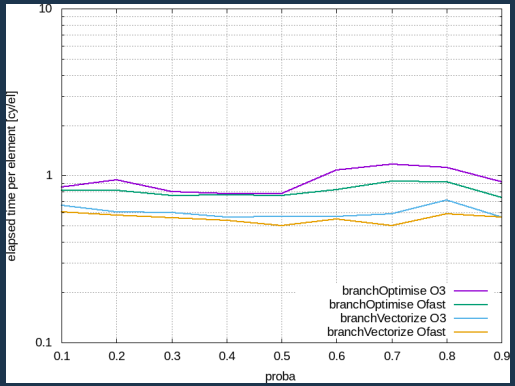
Branching Prediator

Branching probability : vectorize

Total Elapsed Time (cy)

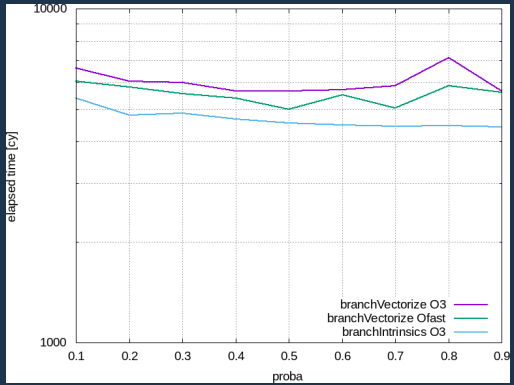


Elapsed Time per element (cy/el)

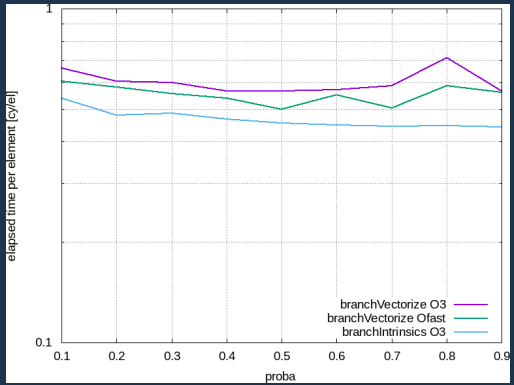


Branching probability : intrisics

Total Elapsed Time (cy)

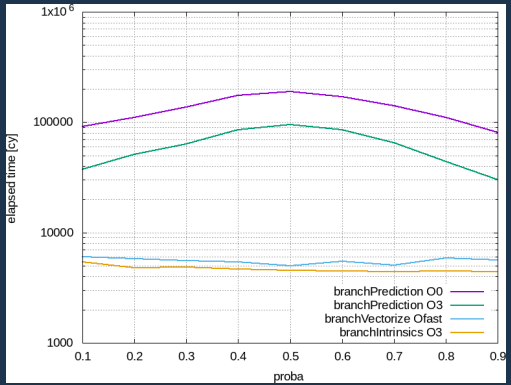


Elapsed Time per element (cy/el)



Branching probability : summary

Total Elapsed Time (cy)



Elapsed Time per element (cy/el)