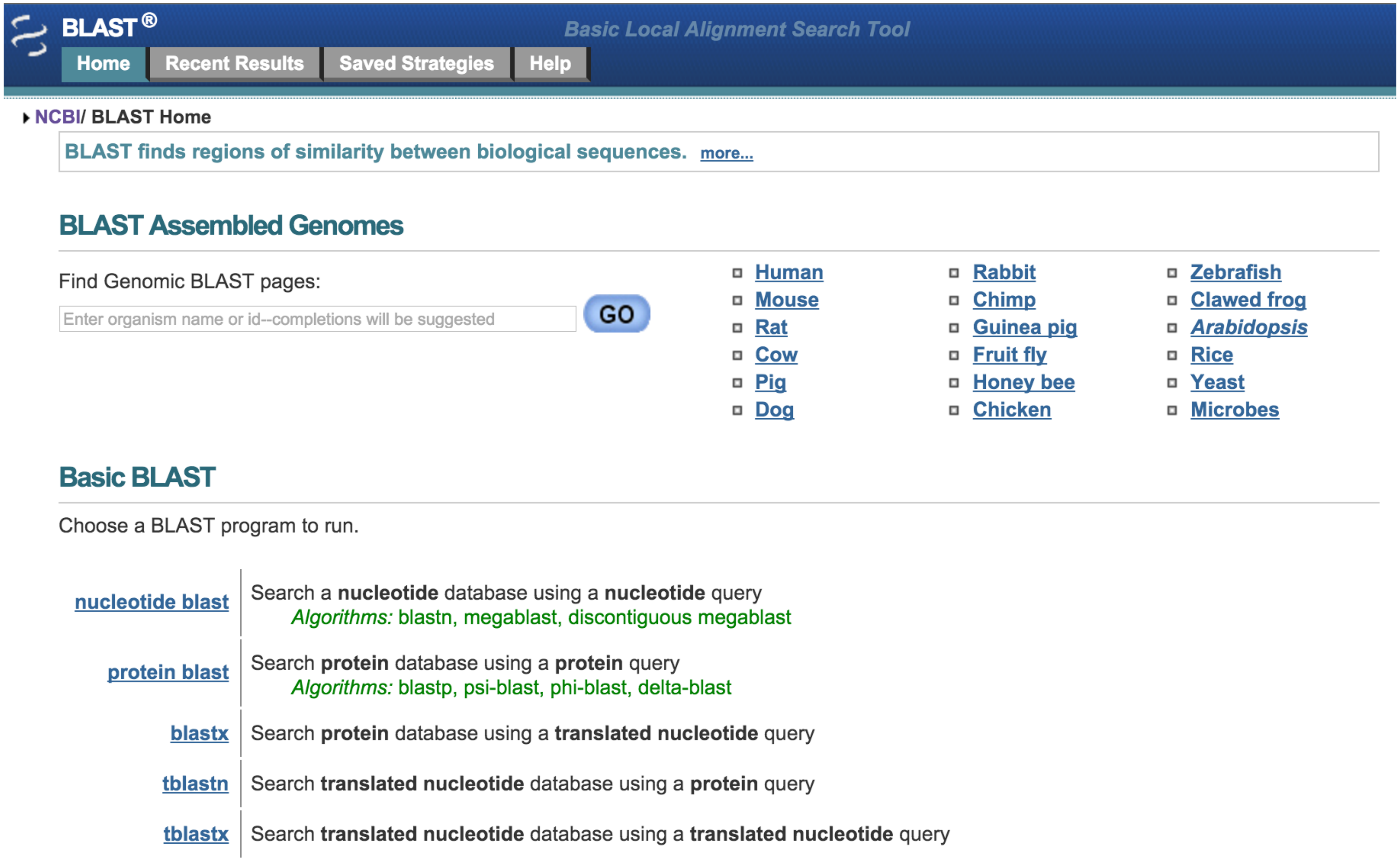
Discussion Section 5

- HW4 questions?
- BLAST algorithm
- If time: the Stack vs. the Heap
  - Using *new* and *delete* in C++

HW4 Questions?

Basic Local Alignment Search Tool (BLAST)



NCBI/ BLAST Home

BLAST finds regions of similarity between biological sequences. more...

BLAST Assembled Genomes

Find Genomic BLAST pages:

Enter organism name or id--completions will be suggested GO

Human	Rabbit	Zebrafish
Mouse	Chimp	Clawed frog
Rat	Guinea pig	*Arabidopsis*
Cow	Fruit fly	Rice
Pig	Honey bee	Yeast
Dog	Chicken	Microbes

Basic BLAST

Choose a BLAST program to run.

nucleotide blast	Search a **nucleotide** database using a **nucleotide** query *Algorithms:* blastn, megablast, discontiguous megablast
protein blast	Search **protein** database using a **protein** query *Algorithms:* blastp, psi-blast, phi-blast, delta-blast
blastx	Search **protein** database using a **translated nucleotide** query
tblastn	Search **translated nucleotide** database using a **protein** query
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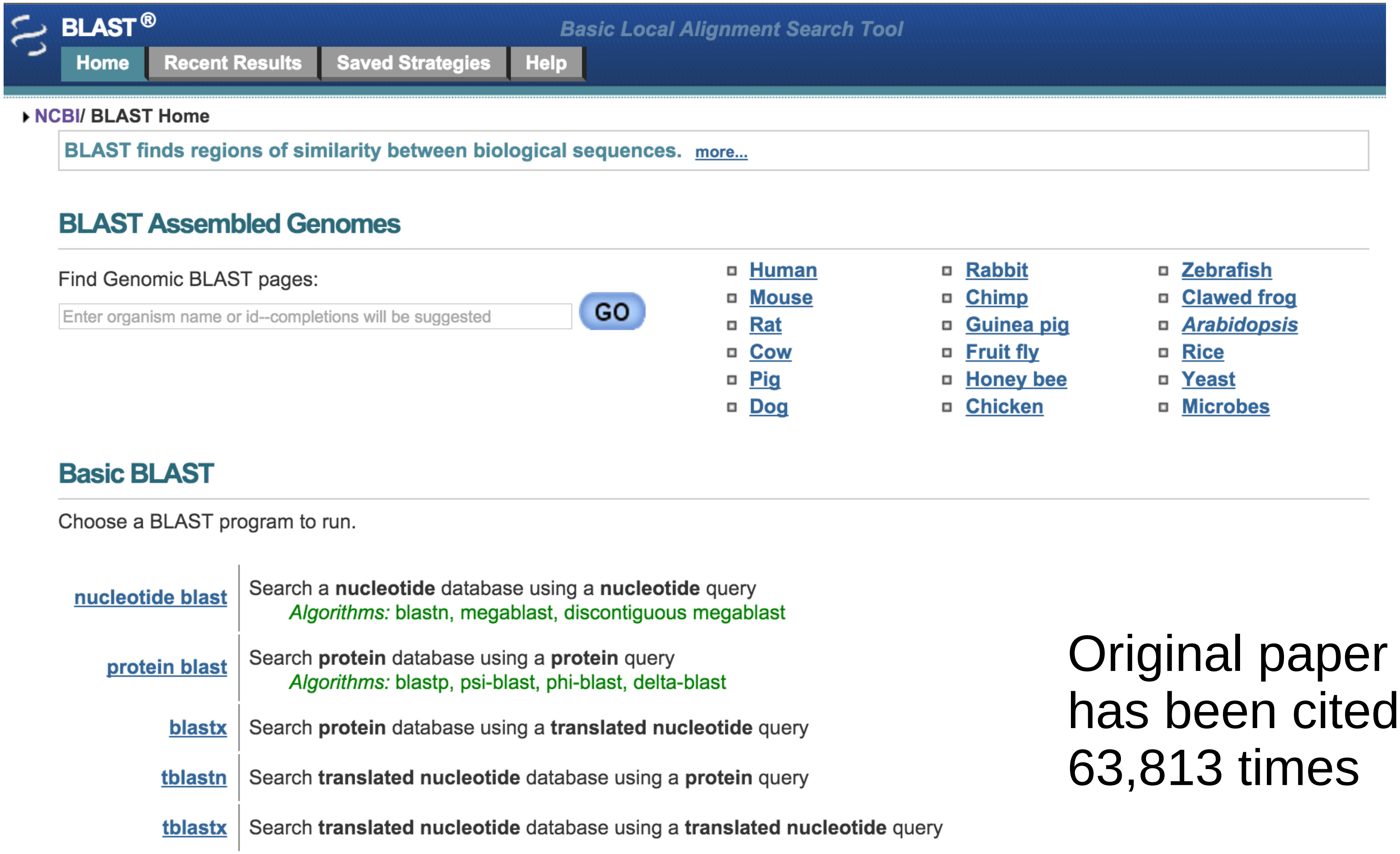

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Original paper has been cited 63,813 times

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Some example matches

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- Filter
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- Heuristic
  - Some false negatives (misses some matches)
  - Some false positives (some incorrect matches)

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N(ABBA) = {ABBA, BBBA, AABA, ABAA, ABBB, AABBA, BABBA, ABBBA, ABABA, ABBAA, ABBAB, BBA, ABA, ABB}

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Only members without prefixes in the neighborhood (why?)

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What *k*-mer size? Something around log *n*

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Overlapping *k*-mers: {PPRHKK, PRHKKM, RHKKMF, HKKMFY, KKMFYA, KMFYAV, MFYAVG}

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  - Finite automaton, like a Mealy machine

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0010110

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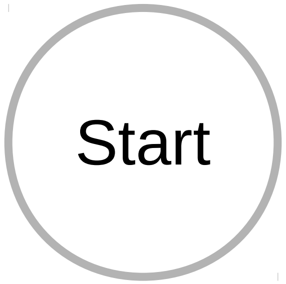

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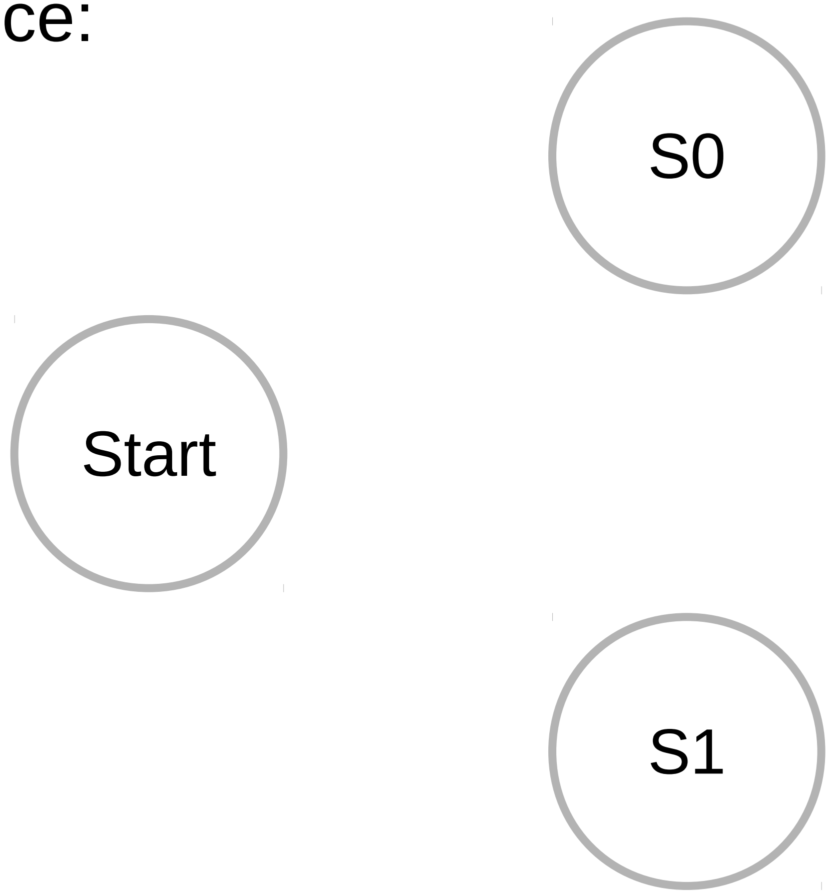

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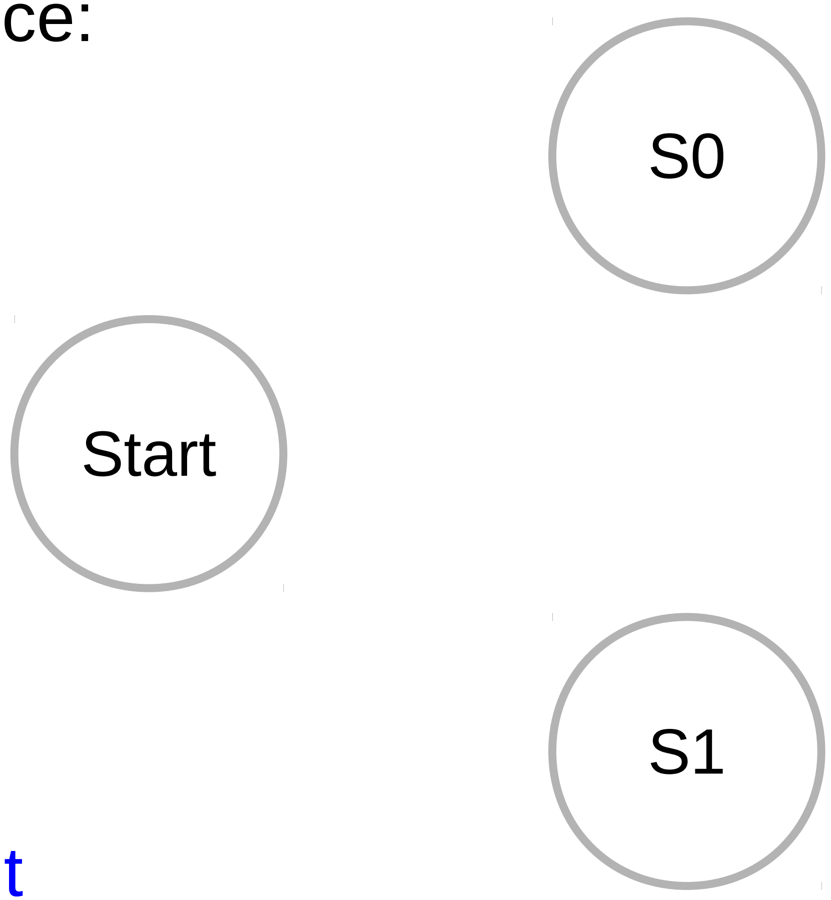

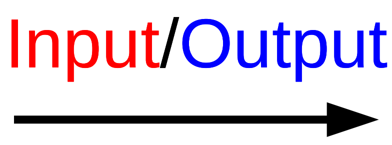

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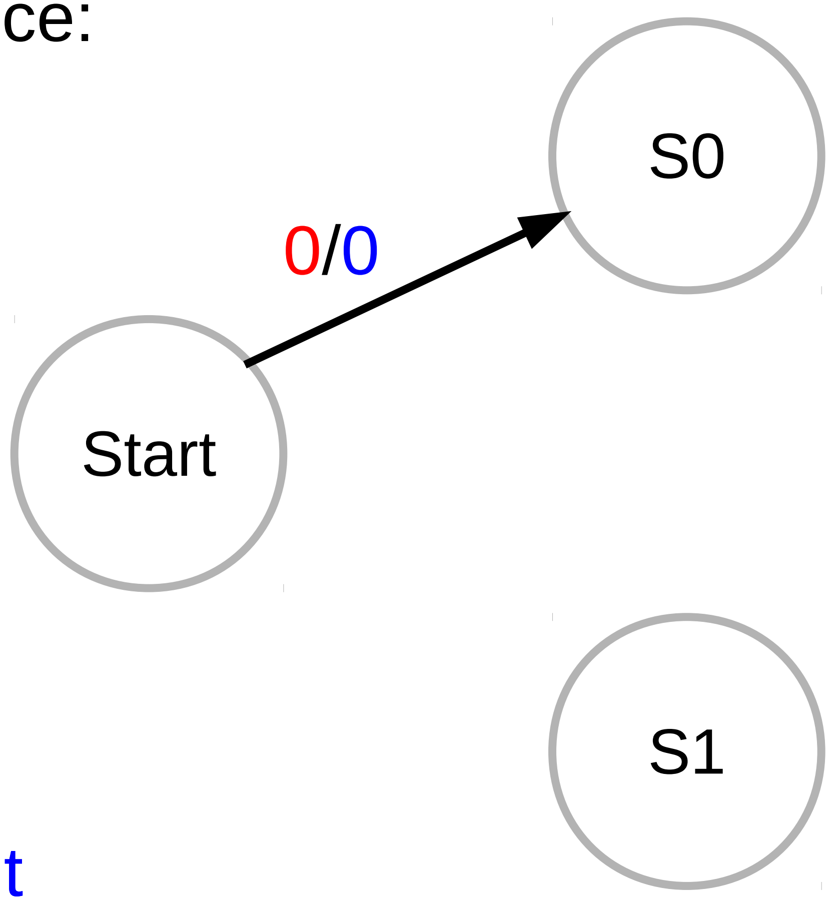

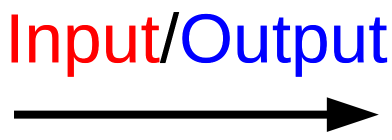

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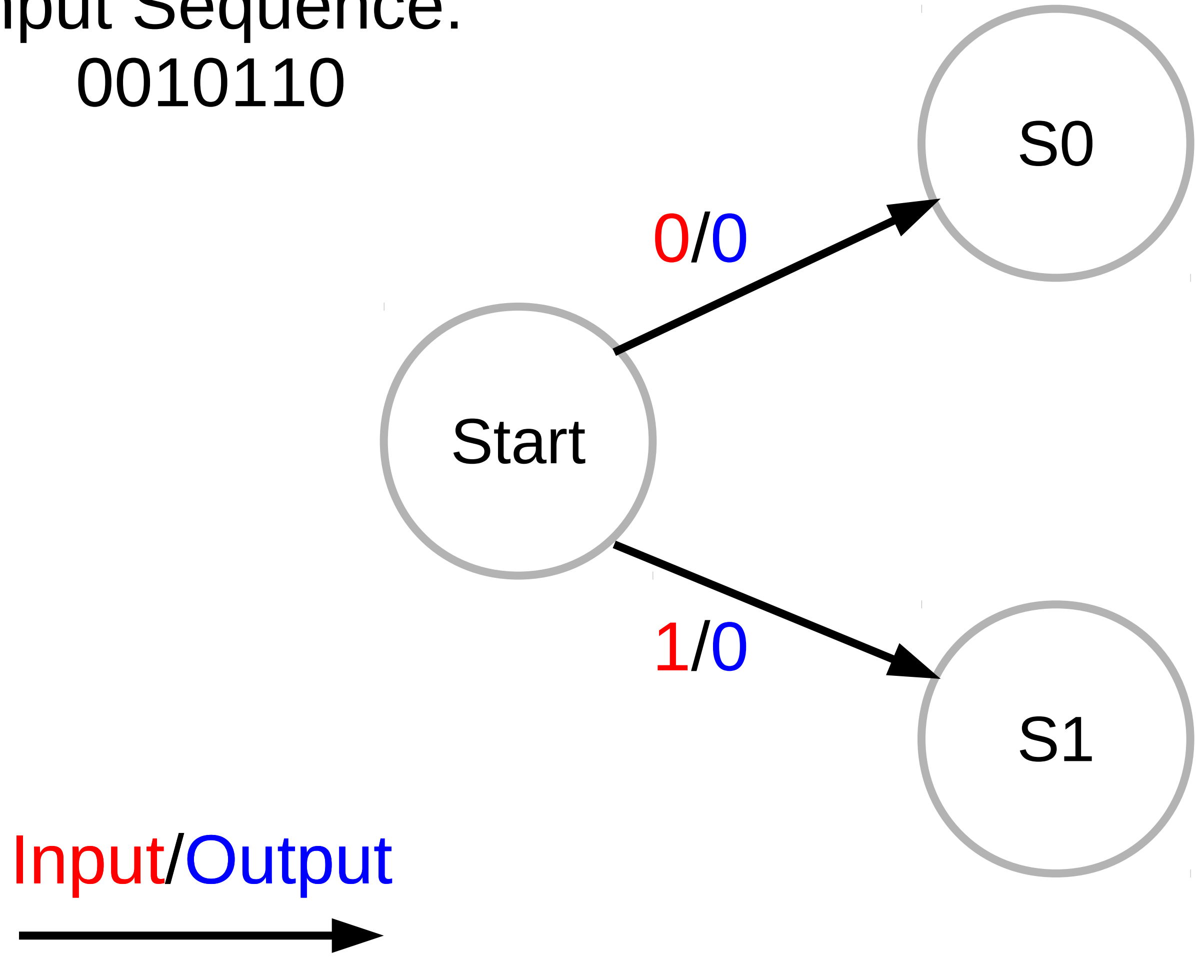

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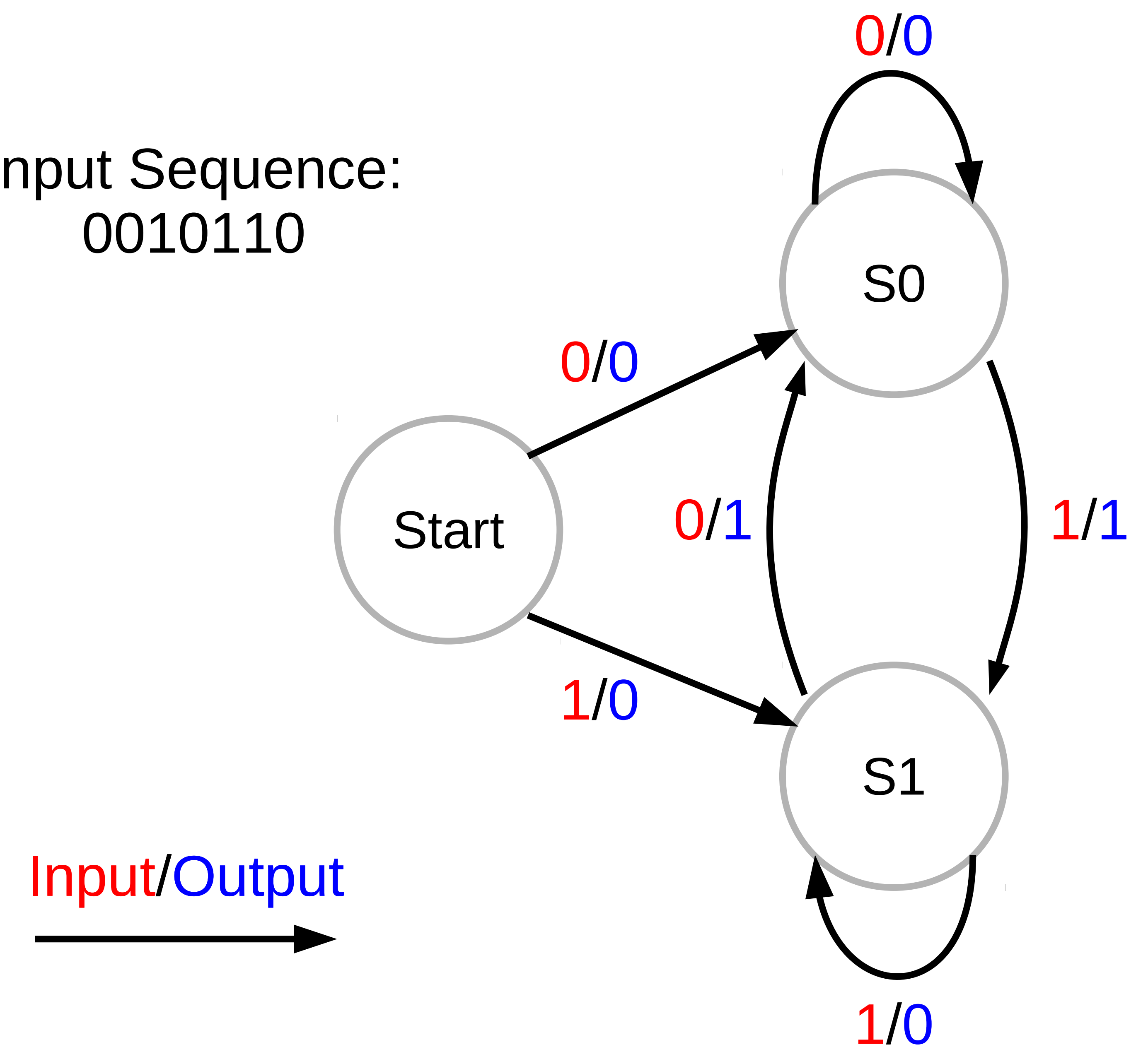

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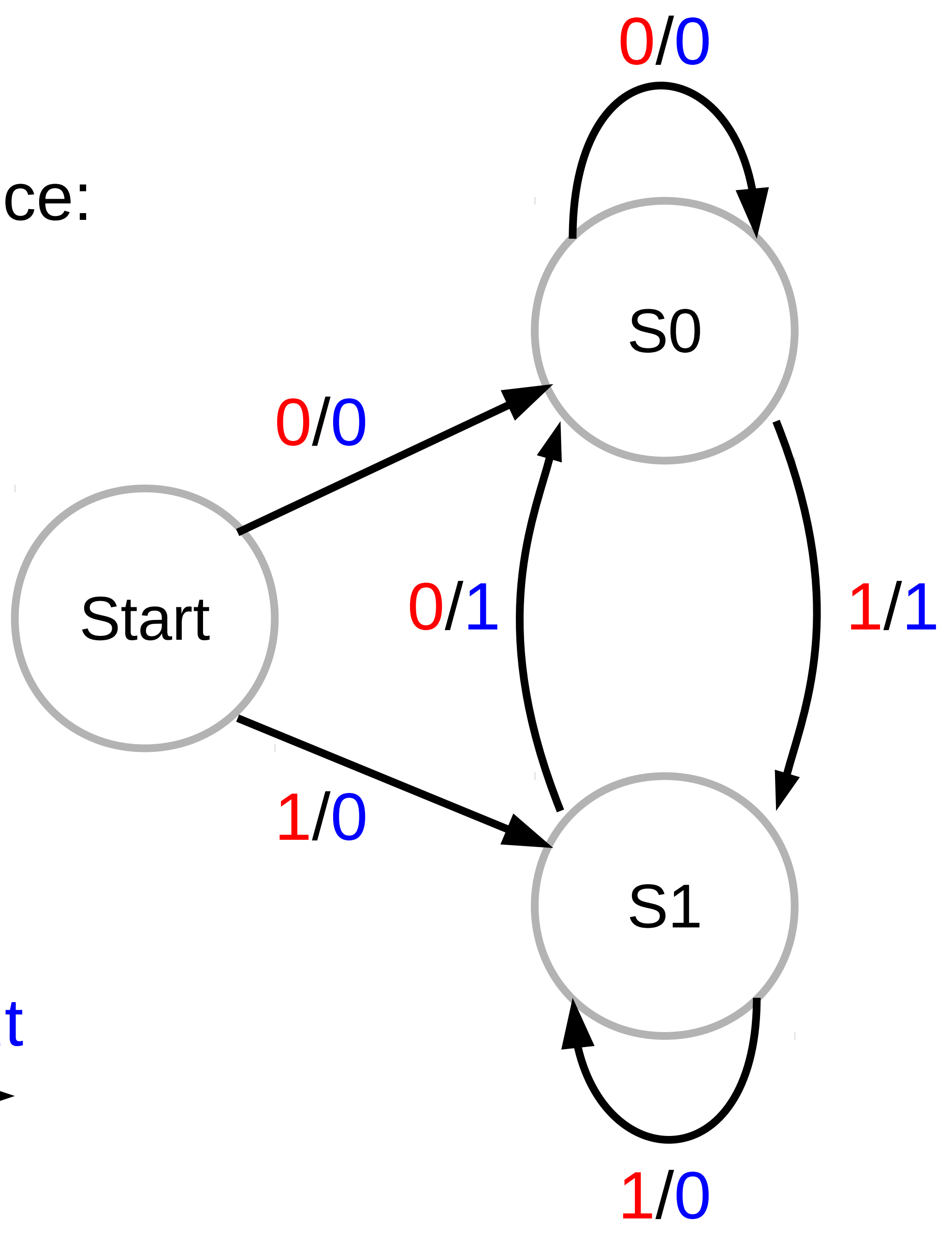

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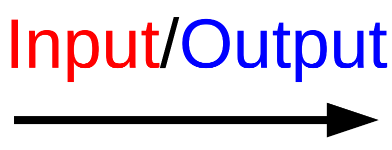

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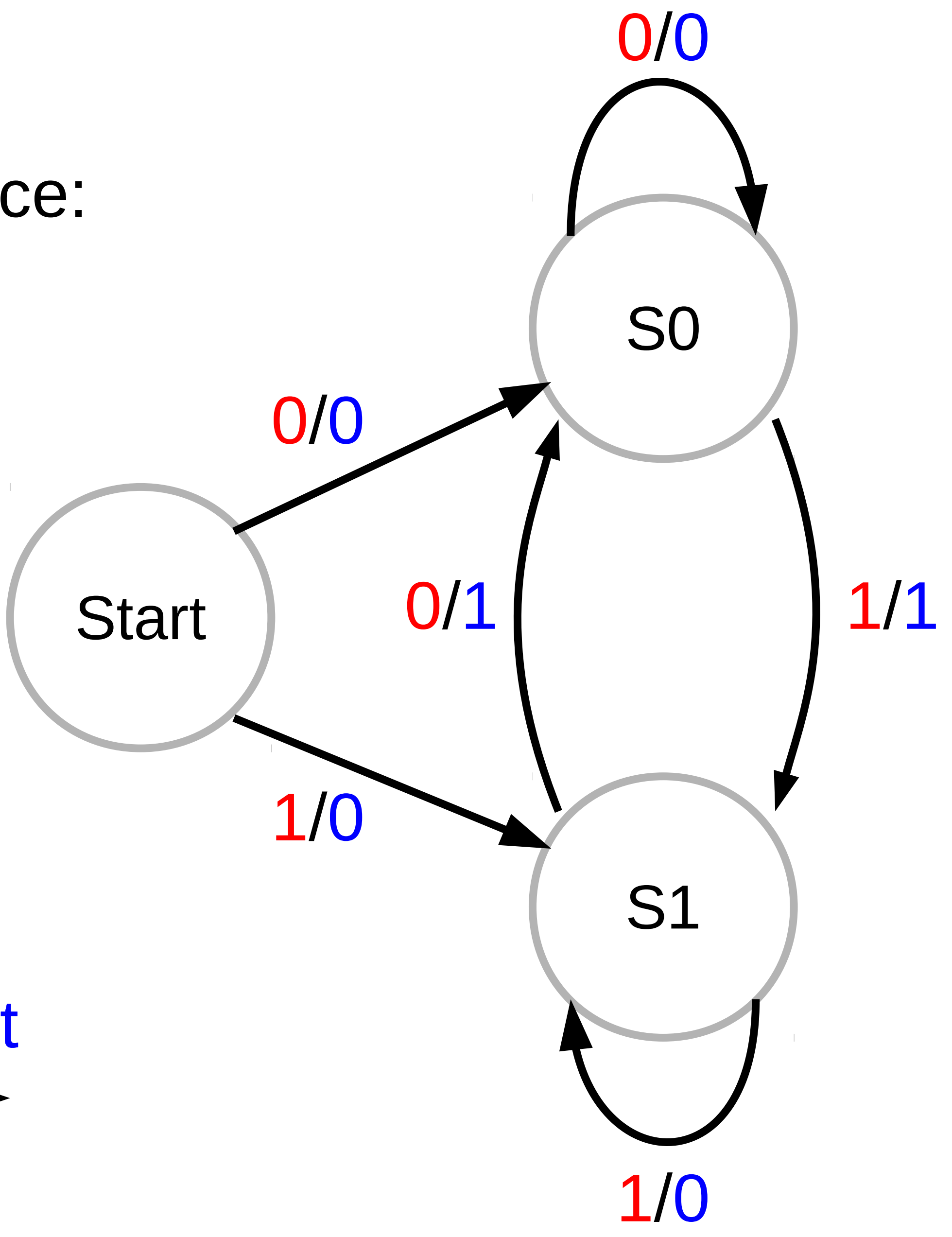
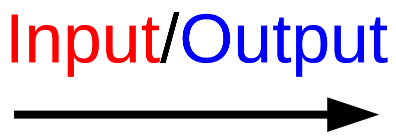


When does it output a 1?

When the previous value is different



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Example:

2*k*-mer: 'PRHKKM'

New candidate match: GAMPRHKKQFFM

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    - E-values based on Gumbel extreme value distribution

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- Generating neighborhoods and extending matches can be done in sublinear time (in terms of the size of the reference)
  - Use a precomputed hash index to look up *k*-mer matches

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- Instead of extending
  - Look for candidate match pairs closer together than some distance threshold
  - Then extend from ends of paired matches
- Can also consider continuing to combine paired matches

Alternatively, you could have Gene Myers explain BLAST

- https://www.youtube.com/watch?v=pVFX3V0Q2Rg
- http://myerslab.mpi-cbg.de/wp-content/uploads/2014/06/behind.blast_.pdf

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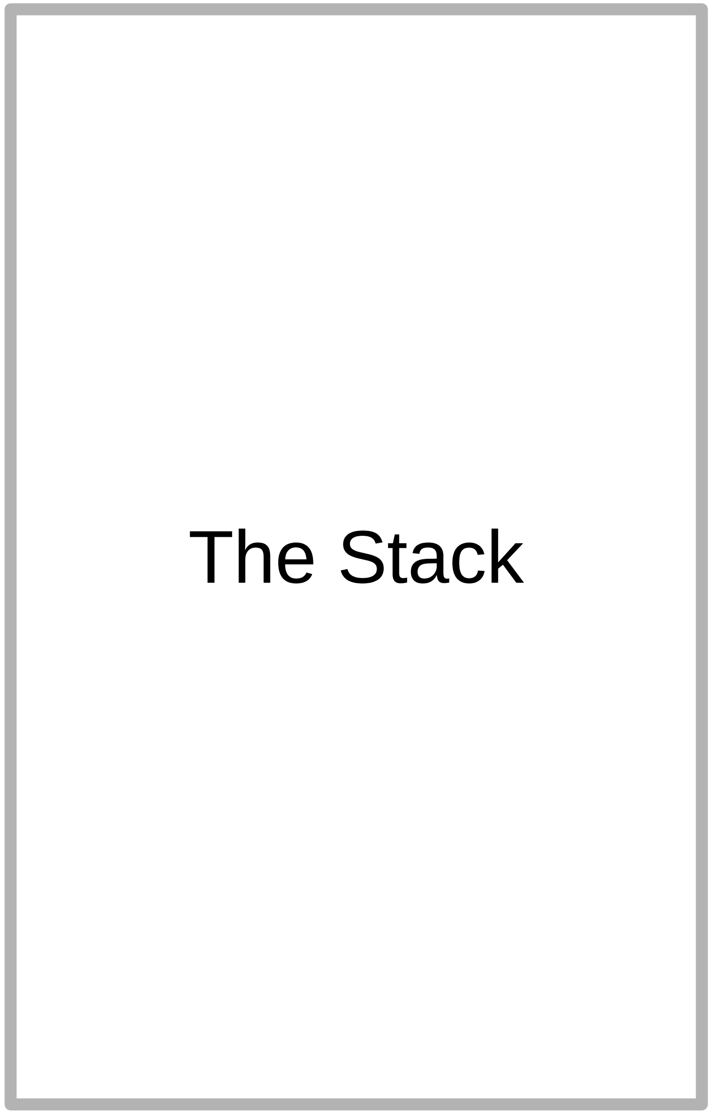

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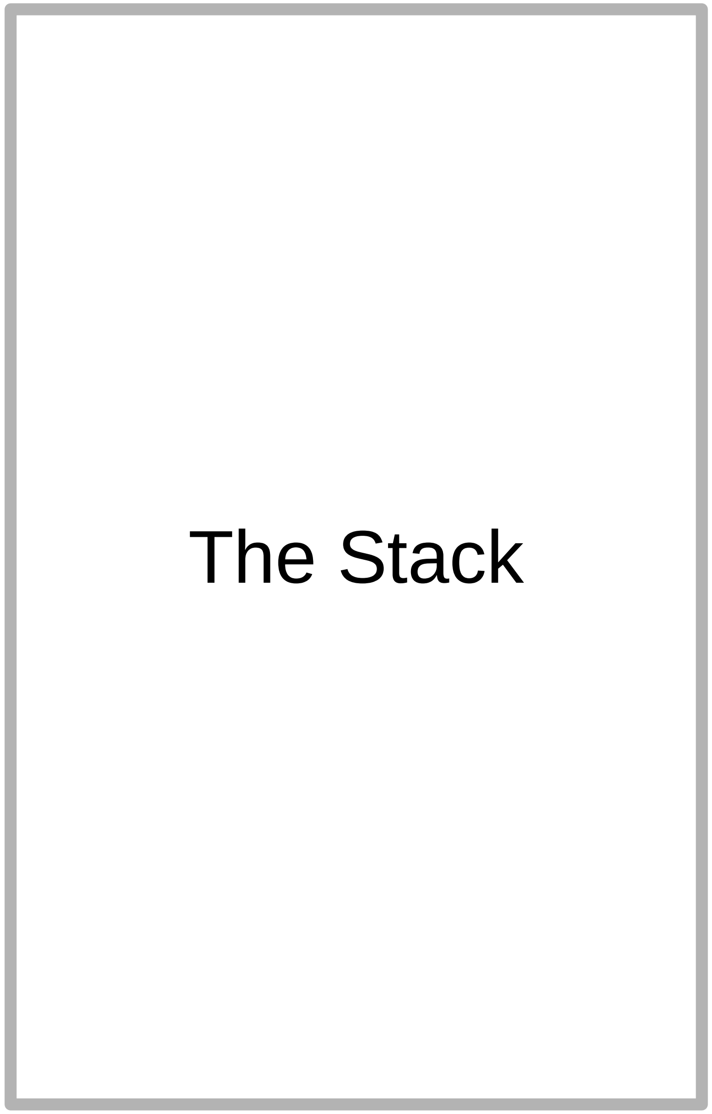

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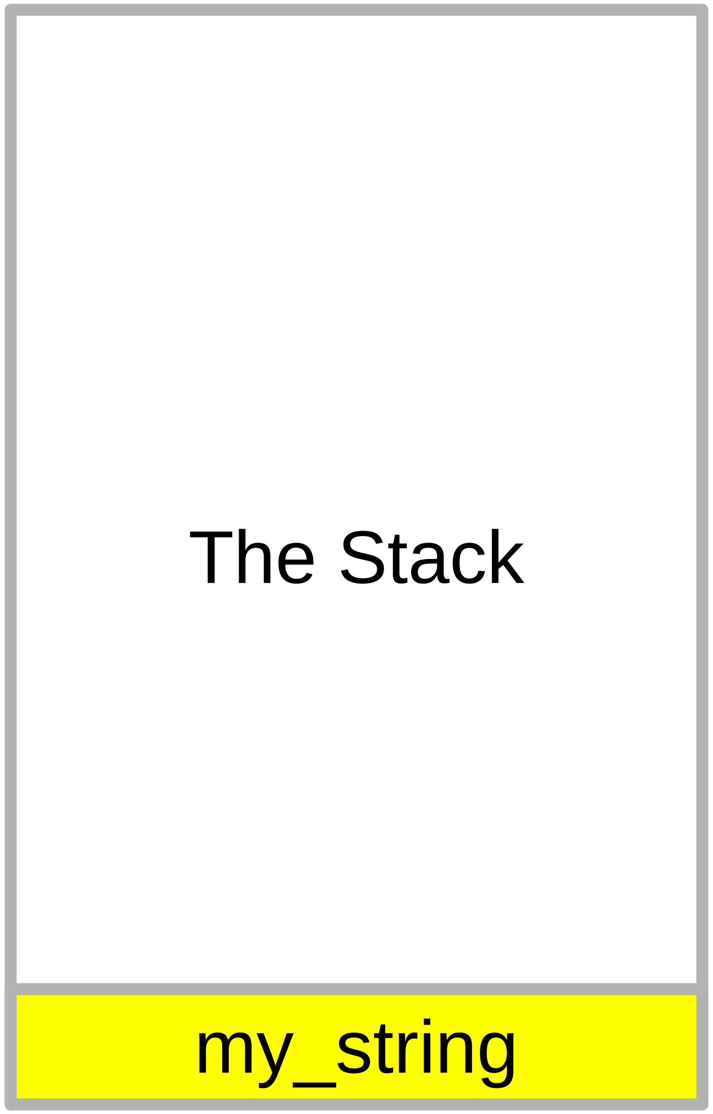

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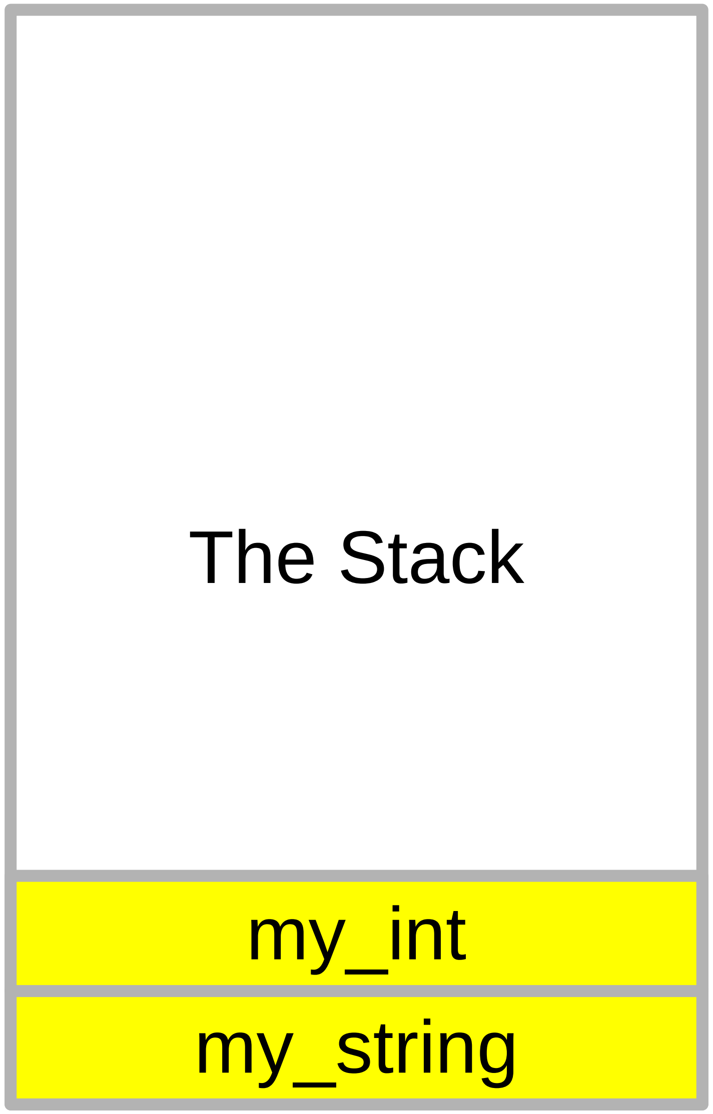

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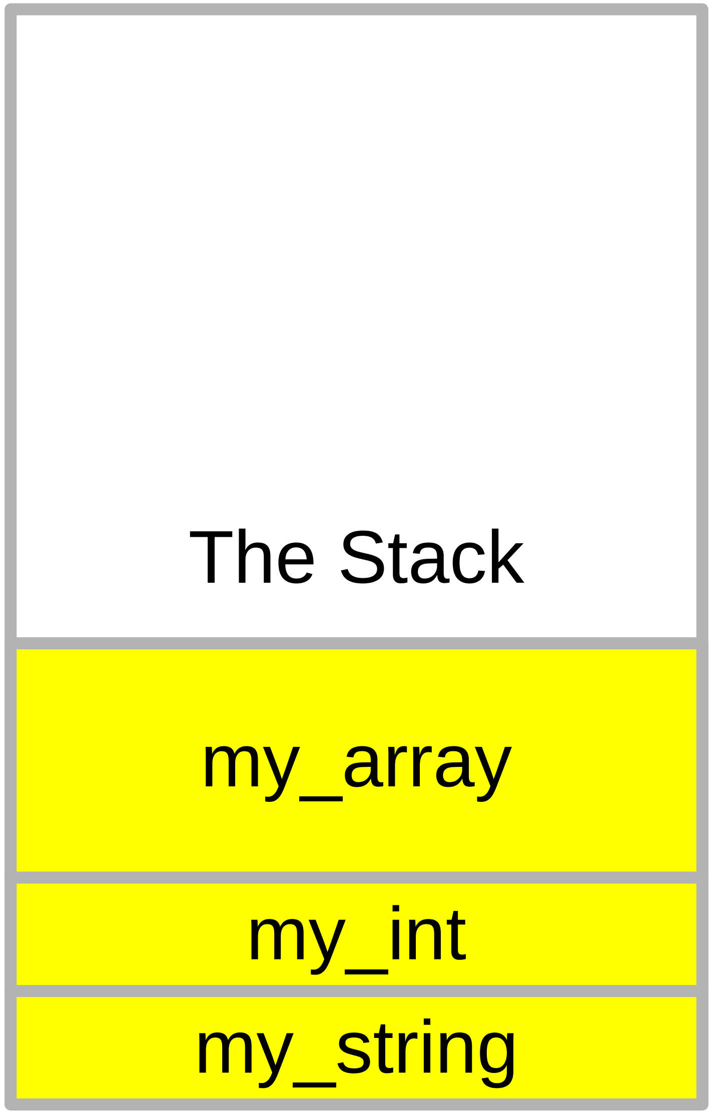

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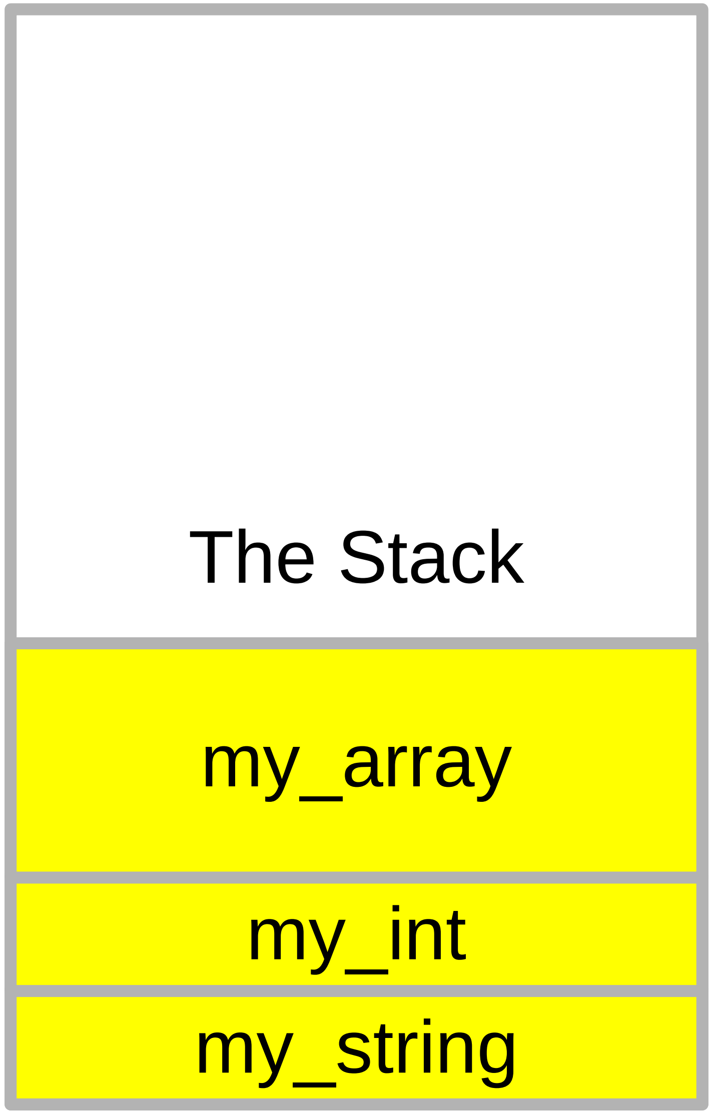

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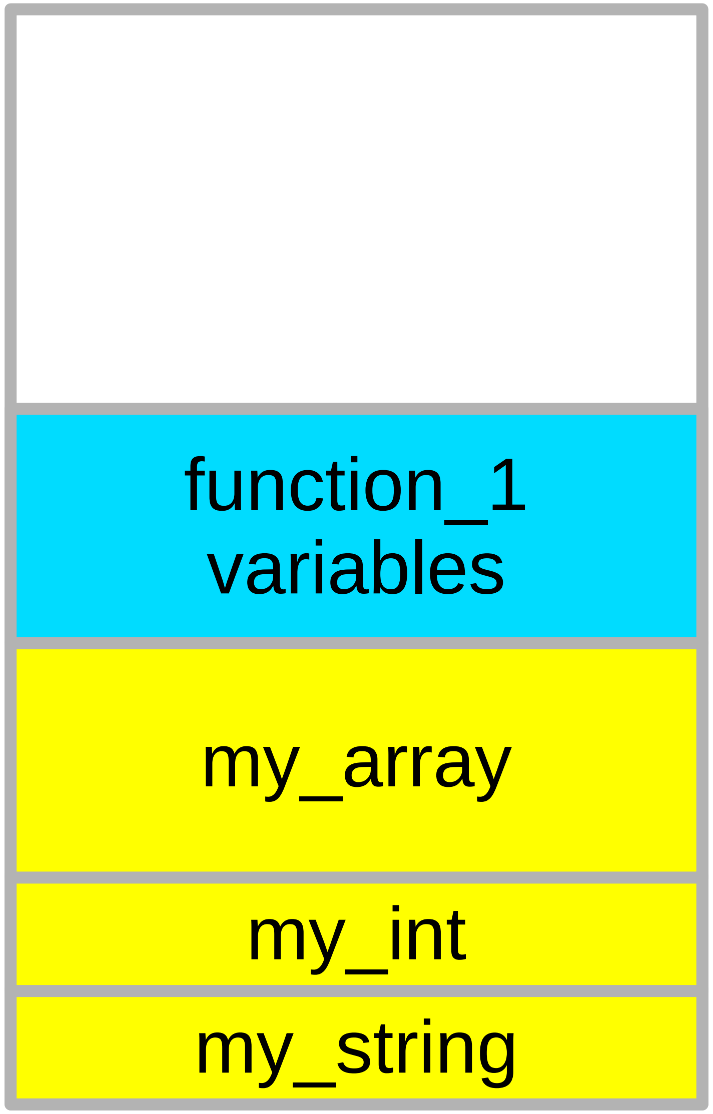

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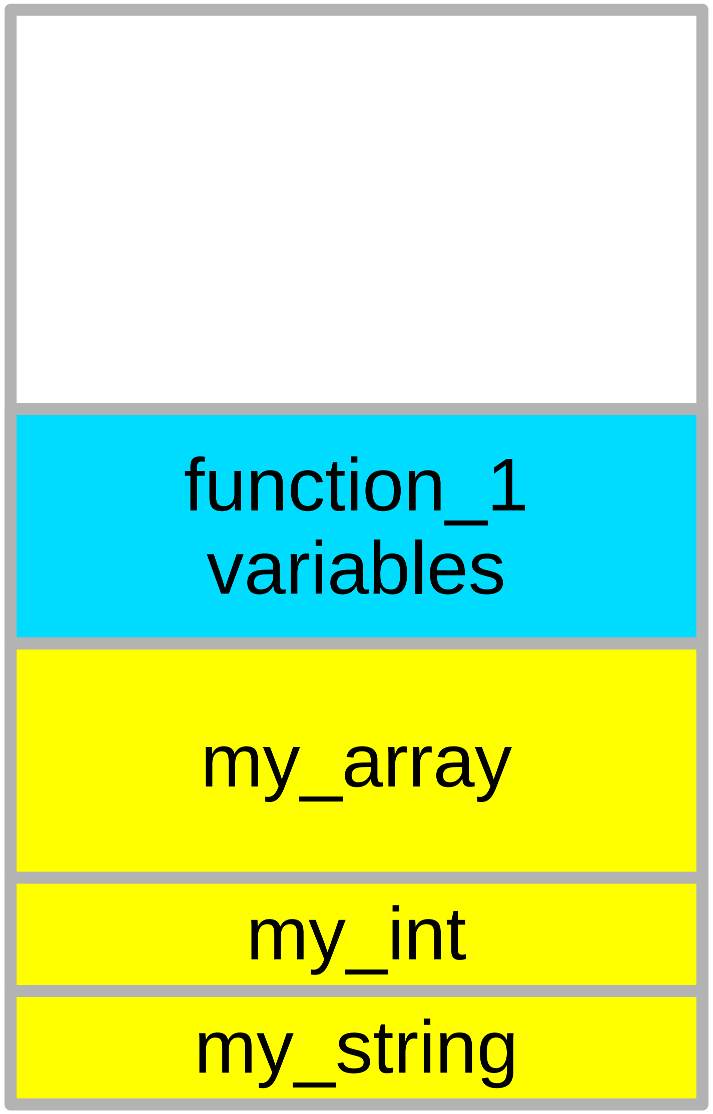
  - This is how scoping gets determined



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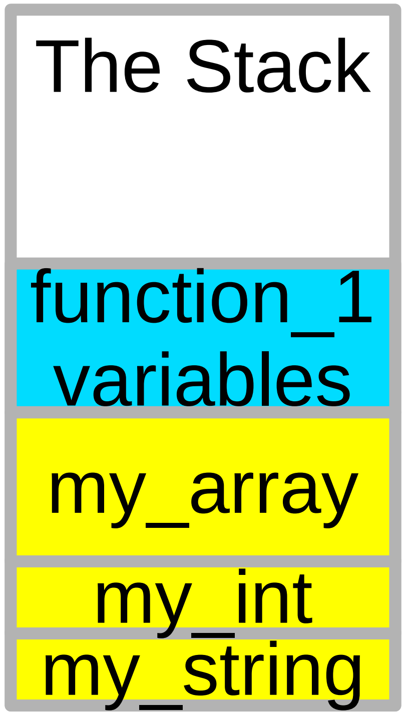

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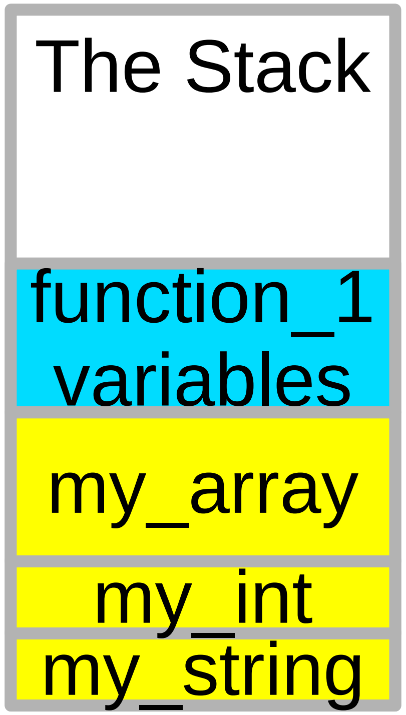
Using *new* and *delete* in C++

- The heap is all non-allocated space in memory



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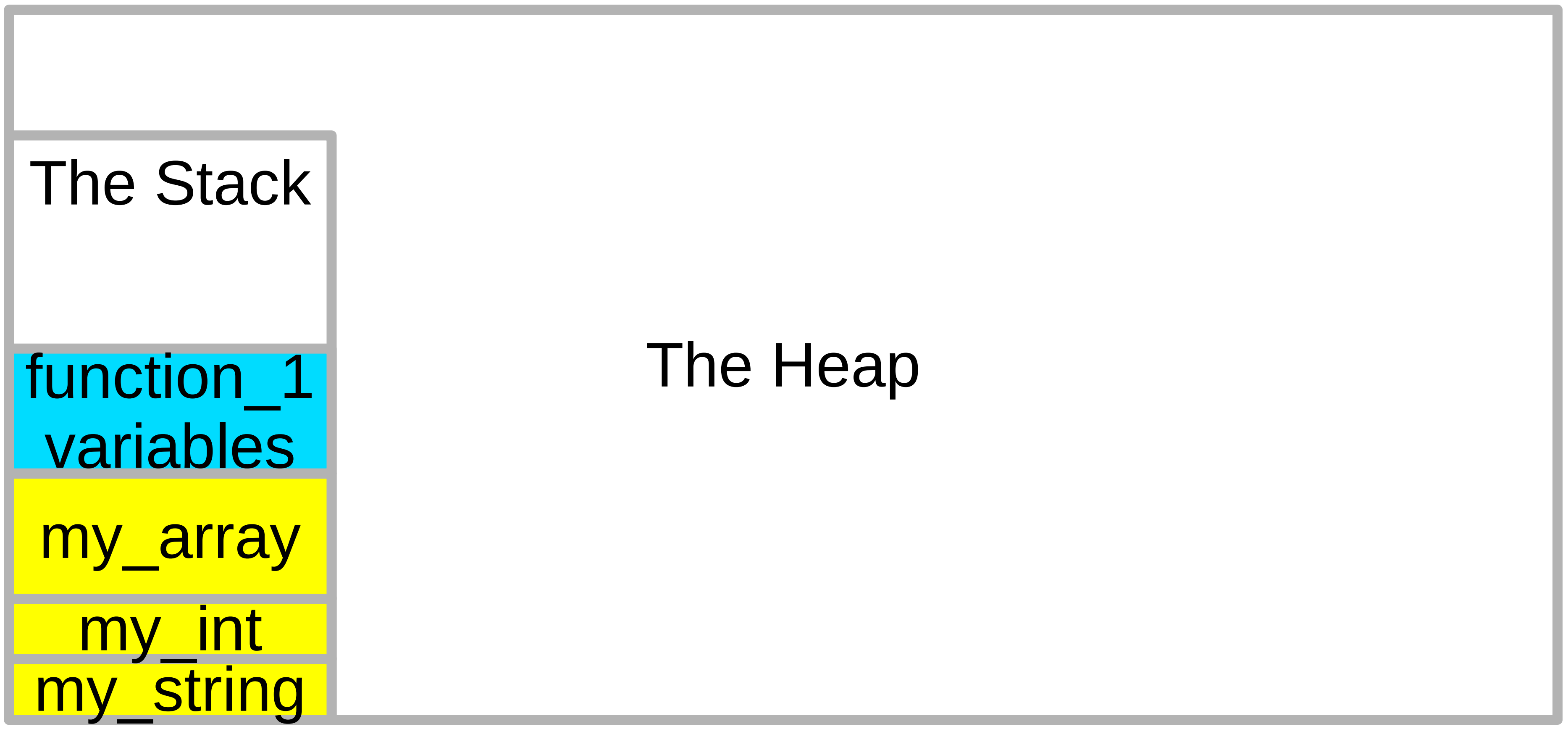

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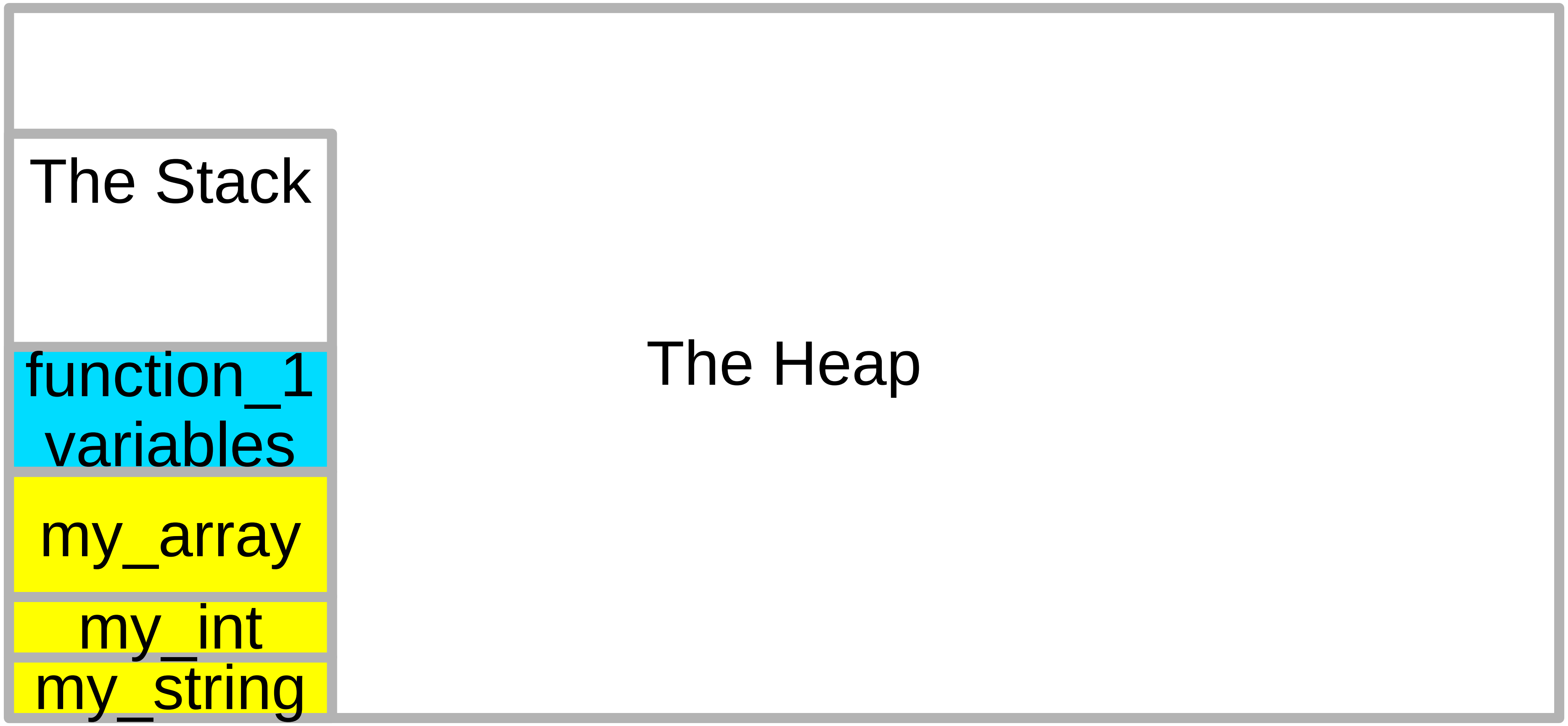

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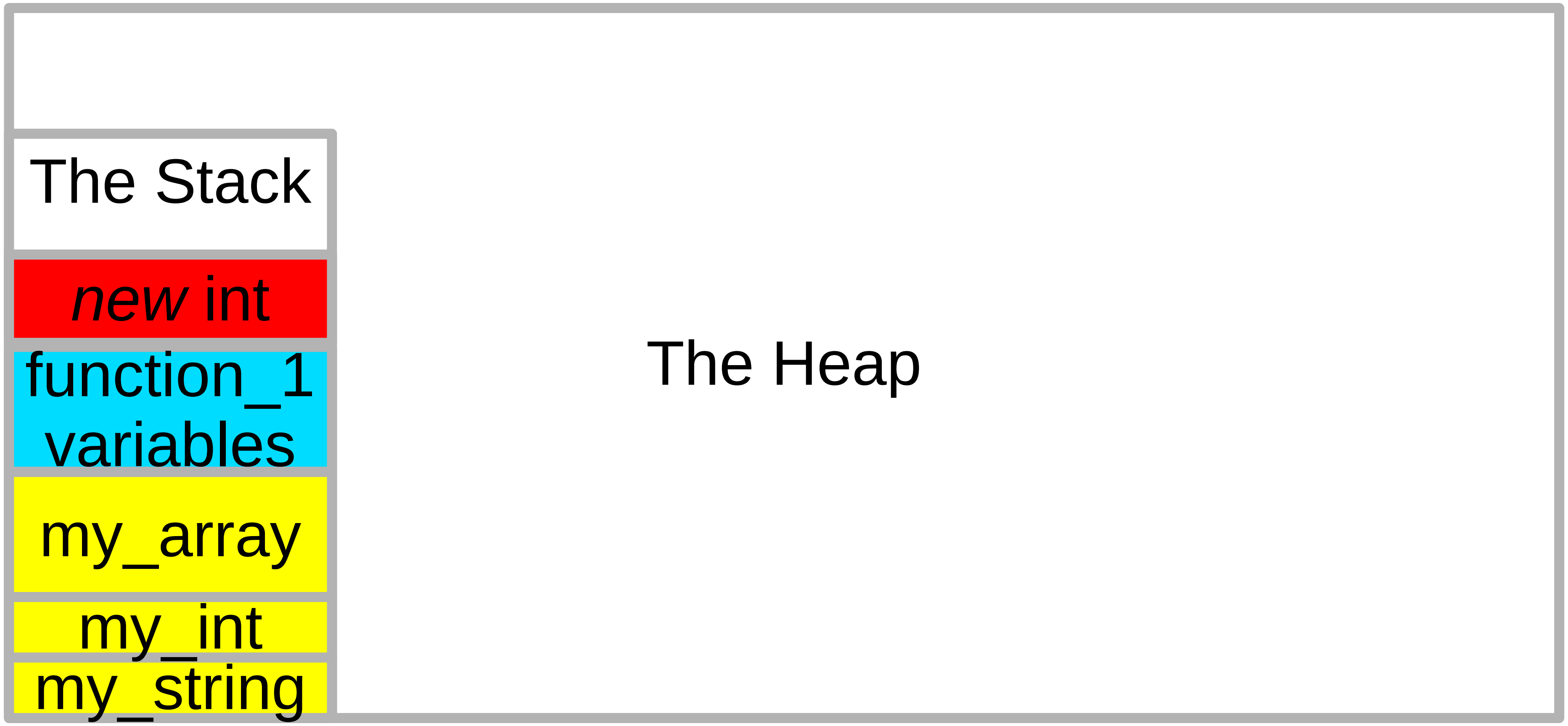

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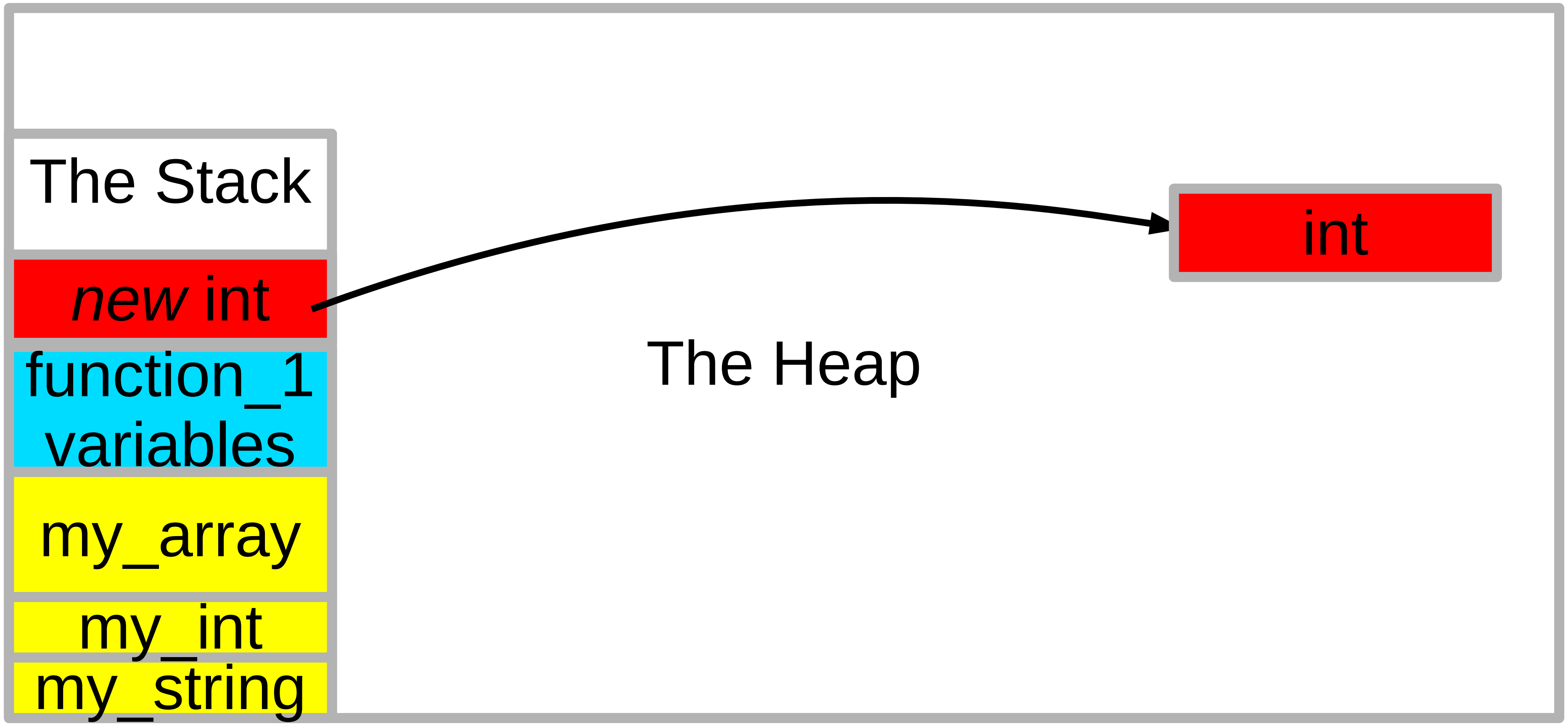

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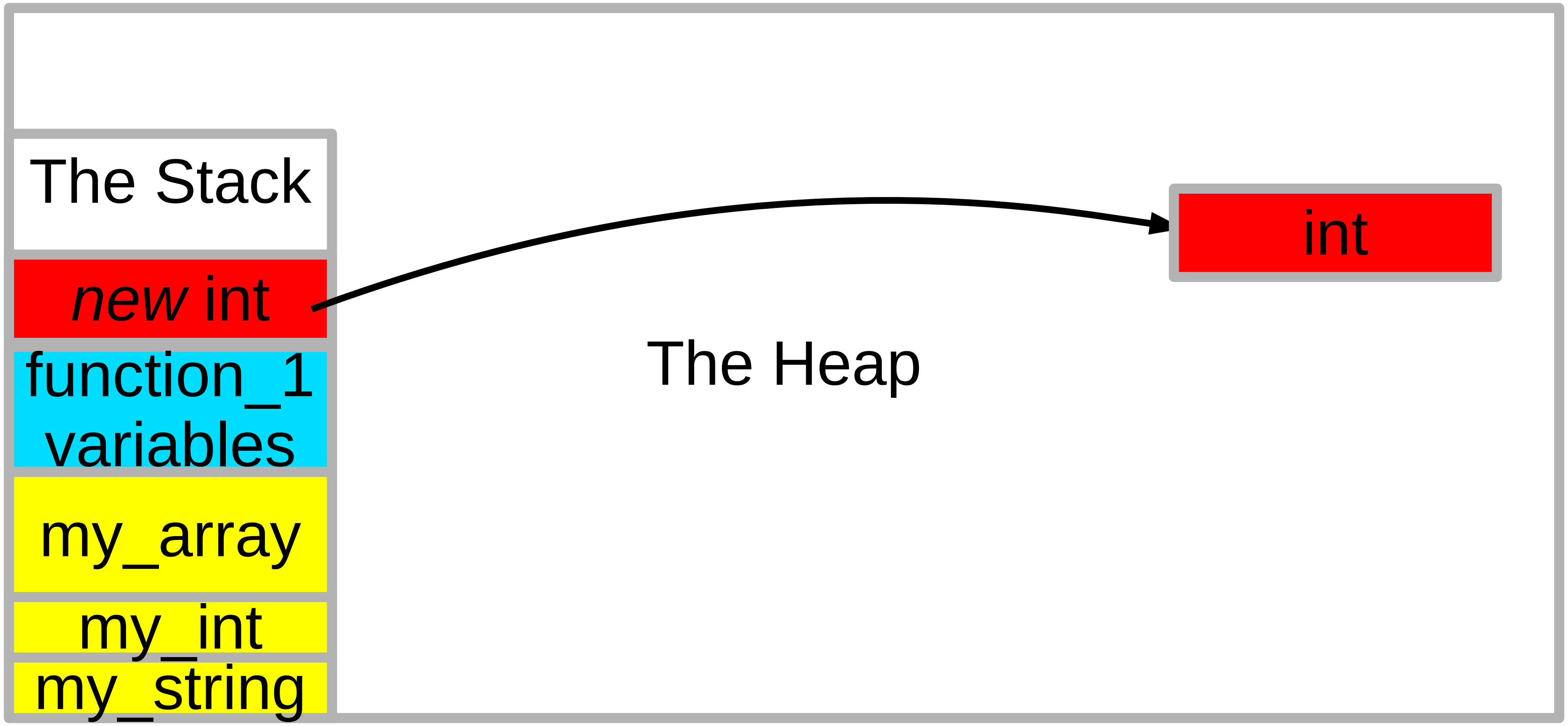
- Using *new* allocates space on the heap for a variable
- *delete* frees the space allocated by *new*



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- Technically, you don't have to use *delete*
  - But what problems could this cause?
    - Memory can't be used again while your program is running
      - It can't even be used by other programs
  - It's a good idea to *delete* things when you're done using them so you're not wasting memory