Introduction to Languages for Scientific Computing

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Ex.1: Partial evaluation

Input (to the function `partial`):

- a (non-overloaded) ternary function f (a function with three arguments)
- a value v
- a position $p \in [1, \ldots, 3]$

Output:

- a binary function $\hat{f}$, resulting from setting p-th argument's of f to v

Goal 1a: Write the function `partial[yourLastName][f_, v_, p_]`

For the challenge: what if the arity (# of arguments) of f is unknown?

Goal 1b: Write the function `total[yourLastName][f_, v_, p_]`

Ex.2: Nested function

Input (to the function `nested`):

- a unary function f
- an integer $k \geq 1$

Output:

- a unary function $\hat{f}$, defined as $\underbrace{f(f(\ldots f}_{k \text{ times}}(\#)\ldots))\&$

Goal 2a: Write the function `nested[yourLastName][f_, k_]`

For the challenge

Goal 2b: Write the function `pure[yourLastName][f_, k_]`, which also returns $\hat{f}$, but does not use any of Mathematica's internal constructs.

Ex.3: Loops

Let `p` denote a permutation of size `n`, and let `cycles[p_]` be a function that returns the cycles in `p`.

1a) Write a function `cycleMax[yourLastName][size_, n_]` that
(i) creates `n` permutations of size `size`,
(ii) for each permutation, computes the length `len` of the longest cycle; then
(iii) for each `len` ($1 \leq$ `len` $\leq$ `size`), plots the number of occurences.

1b) What does the plot of `cycleMax[yourLastName][40, 5000]` look like?

1c) **Challenge:** In a permutation of size 9, what is the probability that the longest cycle has length 6?

2a) Write a function `cycleSize[yourLastName][size_, n_]` that
(i) creates `n` permutations of size `size`,
(ii) for each permutation, computes the length of the cycles; then
(iii) for each `len` ($1 \leq$ `len` $\leq$ `size`), plots the number of occurences.

2b) What does the plot of `cycleSize[yourLastName][40, 5000]` look like?

2c) **Challenge:** In a permutation of size 9, what is the probability that there is a cycle of length 6?

Use `RandomSample` to create random permutations.

All the functions `*Permutation*` and `*Cycles*` are forbidden.

Submission

- Individual assignment.
- Prepare a Mathematica notebook containing the definitions for `partial`, `nested`, `cycleMax`, and `cycleSize`.
- For the challenge, also include the definitions for `total` and `pure`. Furthermore, provide answers to the questions 3.1c and 3.2c.
- Include your name at the top of the notebook.
- Submission by email to `pauldj@aices.rwth-aachen.de`
- Email's subject: either `"LSC-15 HW3 <your last name>"`, or `"LSC-15 Challenge4 <your last name>"`
- **Deadline: Wednesday, December 16, 23.59pm.**