Basic programming

1. `for` and `while`
2. `if .. else` and `if .. else if .. else`
3. `continue` and `break`

Computing integrals

1. Numeric integration: `integral`, `integral2`, `integral3`
2. Symbolic integration: `syms` and `int`

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Exercise

1. Let us write a function which computes the integral $\iint_D f dA$ for rectangular domain $D = [a,b] \times [c,d]$
   (a) First, let us compute the integral line-by-line. Use the example of $f(x,y) = x^2 + y^2$ and $D = [0,1] \times [0,1]$.
   (b) Find the `meshgrid` of D by partitioning each side to 100 subdivisions.
   (c) Using `for` twice, compute the sum $f(x_i, y_i)\Delta x_i \Delta y_i$ where x_i, y_i is the smallest value in the i-th subdivision of each interval and $\Delta x_i, \Delta y_i$ is the length of i-th subdivision.
   (d) Check your result with `integral2(@(x,y)x.^2+y.^2,0,1,0,1)`.

2. Next, we compute $\iint_D f dA$ for the domain given by

$$D = \{a \le x \le b,\, g_1(x) \le y \le g_2(x)\}$$

   For example, let `f = @(x,y) x.*y`, `g1 = @(x) x` and `g2 = @(x) 2*x`.
   (a) Since $D \subset [0,1] \times [0,2]$, find the `meshgrid` of $[0,1] \times [0,2]$ by 100 subdivisions.
   (b) For each subdivision, add $f(x_i, y_j)\Delta x_i \Delta y_j$ to the sum only if $(x_i, y_j) \in D$ using `if`.
   (c) Compare your result with `integral2(f,0,1,g1,g2)`.

3. Let $S = \{(x,y,z) \,|\, z = x^2 - y^2, (x,y) \in [-1,1] \times [-1,1]\}$.
   (a) Find the surface integral $\iint_S xy dS$.
   (b) Find the flux $\iint_S \mathbf{S} \cdot d\mathbf{S}$ of the vector field

$$\mathbf{F}(x,y,z) = (x+y, y+z, x+z).$$

4. Write a function `inner_tri` such that
   - `inner_tri` checks if a point p lies inside the triangle Δ or not.
   - The triangle Δ is bounded by three vertices represented by rows of 3×2 matrix A.
   - The point p is represented by 2×1 (or 1×2) array v
   - The function `inner_tri(A,v)` returns `1` if p lies in Δ, and `0` if not.