Lec 10: Review of Topic 1

Tips

Loops

- To kick start a while-loop even when part of loop header is not valid:

```
n = 0;
while n == 0 || err > tol
    n = n + 1;
    q_approx = ...;
    err = abs(q - q_approx);
end
```

- "short-circuiting" `&&` and `||`

Forming Sums

To calculate $\sum_{j=1}^{n} a_j b_j$:

- using a loop
- using `sum`
- **inner product**

Sequence of Partial Sums

To study the convergence of an infinite series $\sum_{j=0}^{\infty} a_j$, form the sequence of partial sums $\{s_n\}$ where

$$s_n = \sum_{j=0}^{n} a_j = a_0 + a_1 + \cdots + a_n.$$

- using a loop
- using `cumsum`

Simple Examples

Biased Coin

Question

Simulate the tossing of a biased coin with

$$P(\mathsf{T}) = p, \quad P(\mathsf{H}) = 1 - p.$$

Biased Coin – Notes

Ideas.

- random number generators
- traditional tools: loops and conditional statements
- the *powerful* `find` function
- one-liner using `ceil` or `floor`

Explore.

- How would you handle similar situations with multiple states with non-uniform probability profile, *e.g.*, a biased dice?

Dice Rolls

Question

Write a script simulating $n = 10,000$ throws of two 6-sided fair dice. What is the probability of obtaining two same numbers? Provide both analytical and numerical answers.

Finding Factors

Question

Given a positive integer n, finds all factors. Do it using a single MATLAB statement.

Finding Factors – Notes

Ideas.

- the `mod` function: detecting a factor
- the `find` function: do it in one scoop

Explore.

- The built-in function `factor` finds all prime factors. Use it to write a prime factorization of an integer.

Data Manipulation

Download `grades.dat` into your current directory and load it using

```
>> grades = load('grades.dat');
```

To read about how the data are organized, use `type grades.dat`.

Question

1. Determine the number of students.
2. Compute the total grade according to the weights specified in the header. Do this without using a loop.
3. The letter grades are determined by

   - A: $[90, 100]$
   - B: $[80, 90)$
   - C: $[70, 80)$
   - D: $[60, 70)$
   - E: $[0, 60)$

   Find the number of students earning each of the letter grades.

Spiral Triangle: Tying Up Loose Ends

Recall: Entire Code

```
m = 21; d_angle = 4.5;
th = linspace(0, 360, 4) + 90;
V = [cosd(th);
     sind(th)];
C = colormap(hsv(m));
s = sind(150 - abs(d_angle))/sind(30);
R = [cosd(d_angle) -sind(d_angle);
     sind(d_angle) cosd(d_angle)];
hold off
for i = 1:m
    if i > 1
        V = s*R*V;
    end
    plot(V(1,:), V(2,:), 'Color', C(i,:))
    hold on
end
set(gcf, 'Color', 'w')
axis equal, axis off
```

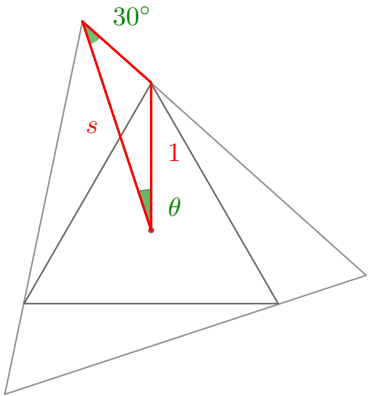
Understanding Line 6

To create the desired spiraling effect, the scaling factor must be calculated carefully.

- Useful:

$$\frac{\sin\alpha}{a} = \frac{\sin\beta}{b} = \frac{\sin\gamma}{c}$$

- Compute the scaling factor s:



Understanding Line 12

```
th = linspace(0, 360, 4) + 90;
V = [cosd(th);
     sind(th)];
s = sind(150 - abs(d_angle))/sind(30);
R = [cosd(d_angle) -sind(d_angle);
     sind(d_angle) cosd(d_angle)];
V = s*R*V;     % <----
```

Understanding Line 5 (More on Coloring)

- Using RGB colors in plots
- `colormap`