L30: Discussion

Numerical Differentiation; Numerical Integration; Project

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Version: release

Announcements

Lab 11 is due on April 14 at 12 pm (noon)

Lab 11 is significantly shorter than most previous labs

Use the opportunity to:

- Get a lot of points on lab 11!
- Work on your project!

Today:

- Numerical differentiation and integration:
  Examples and practice questions
- Project discussion, tips, and recommendations

Next week:

- Ordinary differential equations (Chapter 19)

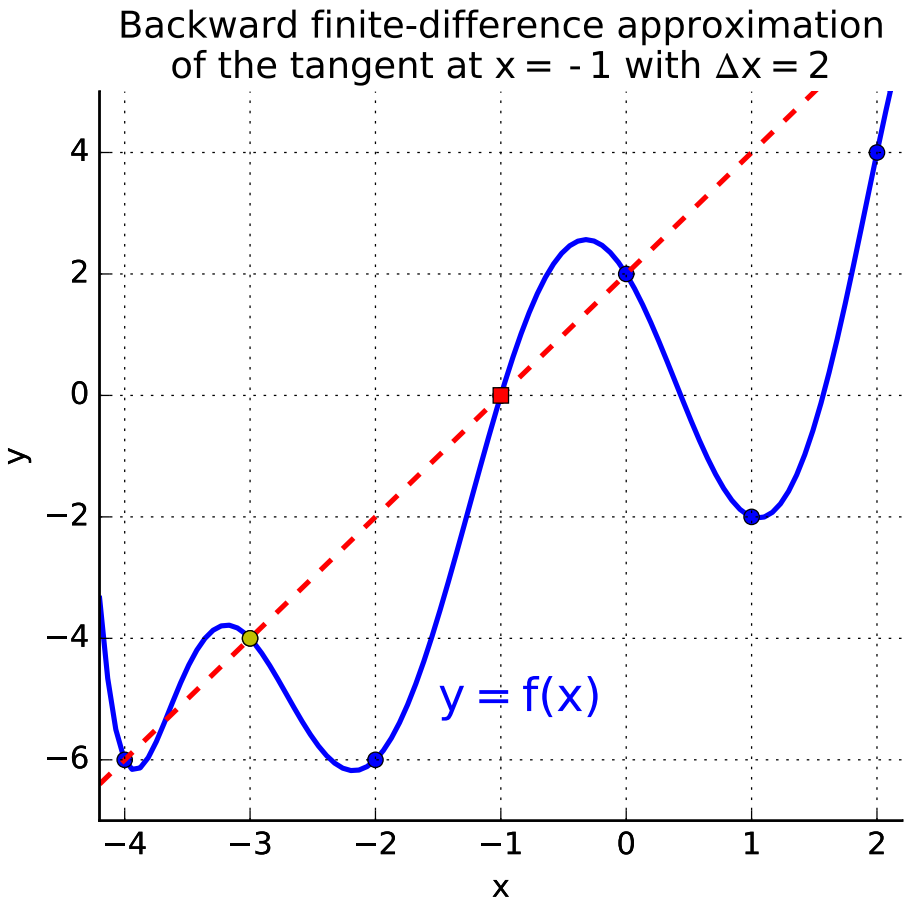
Getting help on lab assignments and on the project

Be proactive about getting help! We are here to help you!

- **Lab sections:** arrive in your Monday or Tuesday lab section, having looked at the lab, and with questions ready
- **My office hours:** I can help you understand the theoretical concepts and the methods used; I can help you work some of the math out on paper
- **bCourses Discussions**:
  - I answer your questions in the corresponding Frequently Asked Questions (FAQ) Page
  - The more questions you ask, the more answers you are likely to get
- **bCourses Frequently Asked Questions (FAQ) Pages:** spend a minute to consult them once or twice a week, you might find useful information there
- **Other bCourses Pages**
- **Friday morning lab drop-in hours**

Numerical differentiation: practice question

What is the value of $f'(-1)$ as estimated by the backward finite-difference approximation with spacing $\Delta x = 2$?



(A) 1

(B) 2

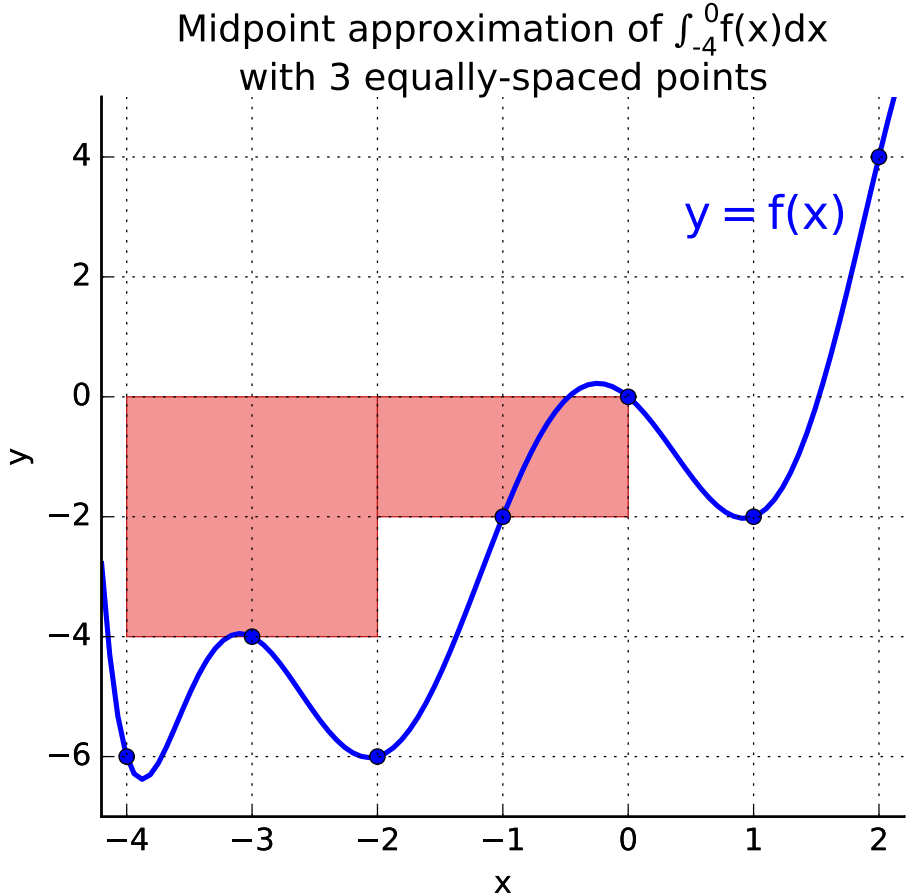
(C) 6

(D) -1

(E) 3

Numerical integration: practice question

What is the value of $\int_{-4}^{0} f(x)dx$ as approximated by the midpoint formula with spacing (*i.e.* width of sub-intervals) $\Delta x = 2$?



(A) -12

(B) 12

(C) -10

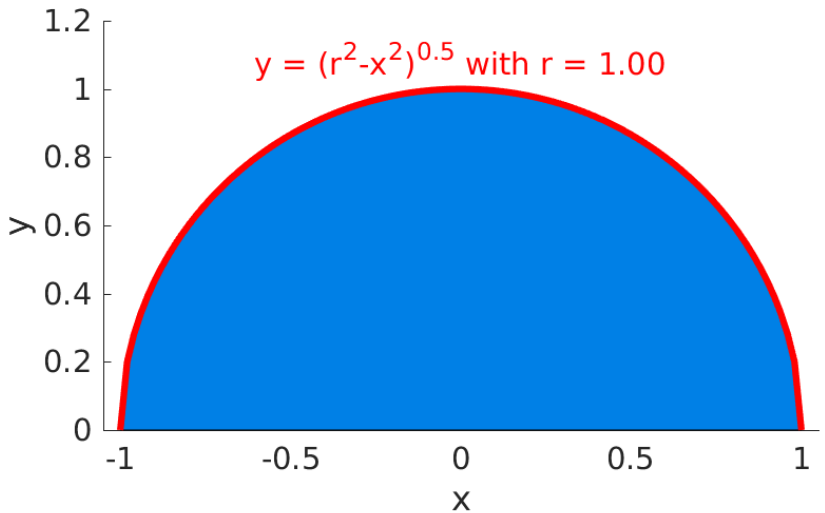
(D) 10

(E) -6

(F) 6

Estimating π using numerical integration

$$\int_{-r}^{r} \sqrt{r^2 - x^2}dx = \text{Area of half-circle of radius r} = \frac{\pi r^2}{2}$$

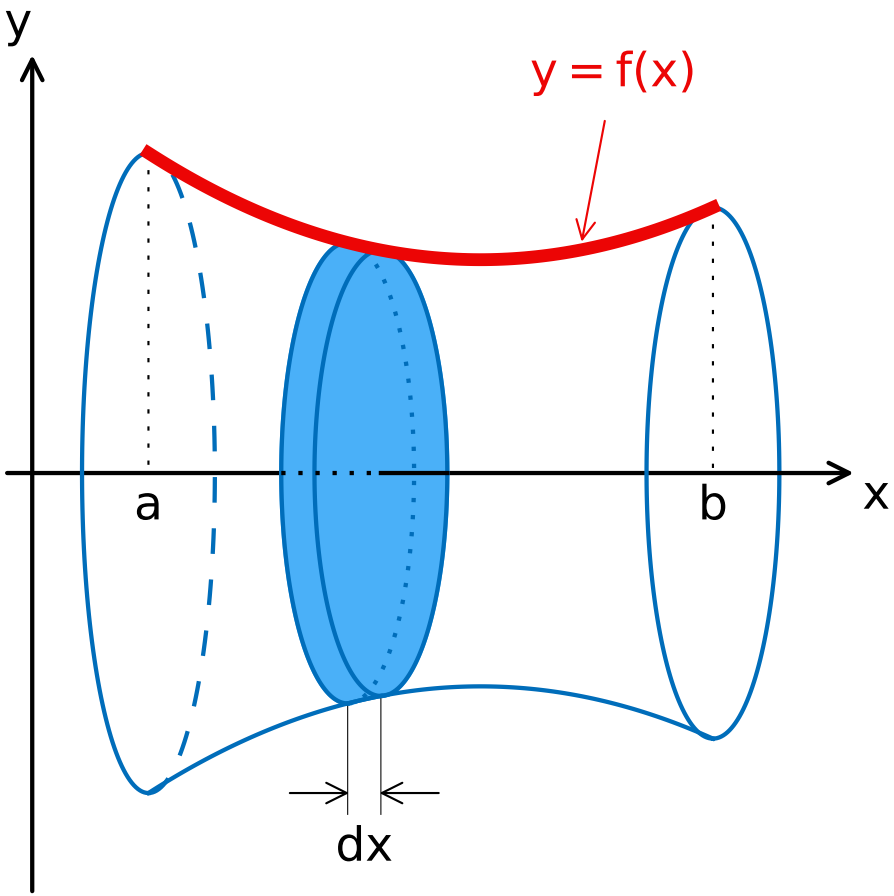


$$\pi = \frac{2}{r^2} \int_{-r}^{r} \sqrt{r^2 - x^2}dx$$

We can use numerical integration to estimate the value of the integral (see script: `estimate_pie_numerical_integration.m`)

Volume of solids of revolution using numerical integration

Question 3 of lab 11: using numerical integration, estimate the volume of solids of revolution given their "profile" *i.e.* the line of equation $y = f(x)$ that is being rotated to form the solid



Volume of the slice of infinitesimally small width dx:

$$\pi f(x)^2 dx$$

Volume V of the solid:

$$V = \sum \text{volume of each slice}$$
$$= \int_a^b \pi f(x)^2 dx$$

Project: grading

- **Beta test (15 points): due Friday April 14^{th} at 12 pm (noon)**
  - Your function will be graded on three maps. Each map will have only one scrap, no impassable areas, no slow-down areas, no ghosts, and wrap-around moves will not be necessary
- **Final code (70 points): due Friday April 28^{th} at 11:59 pm**
  - Graded on multiple maps, which vary in difficulty
- **Final write-up (15 points): due Friday April 28^{th} at 11:59 pm**
  - 1 to 2 pages (no more), PDF format
  - Describe the approach and algorithms that you used in your code
  - Describe in which situations your code works well, and in which situations it does not
  - You can talk about algorithms you tried or wanted to try, but did not end up using in your final code
  - Use sections, headings, and figures as appropriate to support the text

Project: tips and recommendations

It is most likely better to have a function that performs simple tasks well but which cannot handle complex tasks, rather than to have a function that tries to do everything but does not succeed at any of it

Main advice:

- Start with basic functionality, don't try to address every aspect of the problem at once. For example:
  1. Make your spaceship pick up the nearest scrap on maps with no obstacles and no slow-down areas, and without using wrap-around moves
  2. Start thinking about how to go around obstacles, detect which scraps are unreachable, etc.
  3. Start thinking about how to use wrap-around moves
  4. Start thinking about the order in which to pick up scraps
- Divide your code in sub-functions
- Test your code at each step of the process

Project: create your own maps

For example, see the script `create_my_map.m`, that was used to create the following map: