

# FPV Tutorübung

Woche 1

## Implications, Assertions and Conditions

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# Organisatorisches

## Grade Bonus

- Successful participation ( $\geq 70\%$ ) in quizzes and programming tasks will lead to a bonus of 0.3 in the final exam, provided that you passed the exam.
- Programming homework and quizzes are to be submitted individually.
- Discussing solutions before the end of the week is considered plagiarism.
- Plagiarism will not be tolerated and will (at the very least) lead to exclusion from the bonus system

## Changes

- Manual correction of homework not possible. However, non-programming exercises remain crucial for the exam
- 20% of the exam will be Single-Choice
- To receive points in the exam, your code needs to compile
- We currently anticipate an in-person exam using Artemis

# Materialien

The screenshot displays the GitHub repository page for `ManuelLerchner/fpv-tutorial-SS23`. The repository is public and has 334 commits. The main branch is `master`, with 1 branch and 0 tags. The repository was last updated 2 weeks ago.

The repository structure includes the following files and folders:

- `.github/workflows`: fix (2 weeks ago)
- `docs`: Update PDFs (2 weeks ago)
- `md`: add slide template (2 weeks ago)
- `ocaml`: clean up project (2 weeks ago)
- `slides`: clean up project (2 weeks ago)
- `.gitignore`: improve rendering (2 weeks ago)
- `README.md`: add slide template (2 weeks ago)
- `render.sh`: initial commit (last month)

The `README.md` file is selected, showing the title **FPV Tutorial - SS23**. Below the title, there are two status indicators: `Rerender PDFs` (passing) and `Deploy static content to Pages` (passing). The **About** section states: "Materialien für Manuel's FPV-Tutorium im Sommersemester 2023." and "Die Materialien sind privat erstellt und können Fehler enthalten. Im Zweifelsfall haben immer die offiziellen".

The right sidebar shows the repository's **About** section, including the link `manuellernher.github.io/fpv-tutorial-SS...`, 0 stars, 1 watching, and 0 forks. The **Environments** section shows `github-pages` as **Active**. The **Languages** section shows a progress bar for `OCaml` (61.5%) and `Shell` (38.5%).

# Quiz



Artemis 6.1.3

Courses > Funktionale Programmierung und Verifikation (Sommersemester 2023) > Exercises > Week 02 Quiz

✓ Week 02 Quiz **Quiz**

Points: 20

[Open quiz](#)

The quiz is not active.

**Communication**

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# T01: Recap Implications

1.  $x = 1 \implies 0 < x$
2.  $x < 6 \implies x = 3$
3.  $x > 0 \implies x \geq 0$
4.  $x = -2 \implies x < -1 \vee x > 1$
5.  $x = 0 \vee x = 7 \implies 4 \neq x$
6.  $x = 1 \implies x \leq 3 \wedge y > 0$
7.  $x < 8 \wedge y = x \implies y \neq 12$
8.  $x = 1 \vee y = 1 \implies x > 0$
9.  $x \neq 5 \implies \text{false}$
10.  $\text{true} \implies x \neq y$
11.  $\text{false} \implies x = 1$
12.  $x \geq 1 \implies 2x + 3 = 5$
13.  $A \wedge x = y \implies A$
14.  $B \implies A \vee B$
15.  $A \implies (B \implies A)$
16.  $(A \implies B) \implies A$

# T02: Assertions



1. Which of the following assertions hold at point *A*?

- a)  $i \geq 0$
- b)  $x = 0$
- c)  $i \leq 10 \wedge x \neq 0$
- d) *true*
- e)  $i = 0$
- f)  $x = i$

2. Which of the following assertions hold at point *B*?

- a)  $x = 0 \wedge i = 0$
- b)  $x = i$
- c)  $i < x$
- d)  $0 \leq i \leq 10$
- e)  $i \geq 0 \wedge x \geq 0$
- f)  $n = 1 \implies x = i$

3. Which of the following assertions hold at point *C*?

- a)  $i \geq 0$
- b)  $i = 10$
- c)  $i > 0$
- d)  $x \neq n$
- e)  $x = 10n$
- f)  $x = i * n \wedge i = 10$

# T03: The Strong and the Weak

3. Which of the following assertions hold at point  $C$ ?

- a)  $i \geq 0$  ✓
- b)  $i = 10$  ✓
- c)  $i > 0$  ✓
- d)  $x \neq n$  ✗
- e)  $x = 10n$  ✓
- f)  $x = i * n \wedge i = 10$  ✓

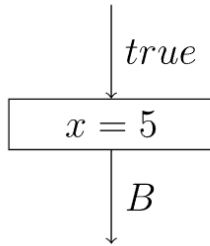
Again consider the assertions that hold at point  $C$  of assignment 2. Discuss the following questions:

1. When annotating the control flow graph, can you say that one of the given assertions is "better" than the others?
2. Can you arrange the given assertions in a meaningful order?
3. How can you define a *stronger than* relation formally?
4. How do *true* and *false* fit in and what is their meaning as an assertion?
5. What are the strongest assertions that still hold at  $A$ ,  $B$  and  $C$ ?



# T04: Strongest Postconditions 1

1.



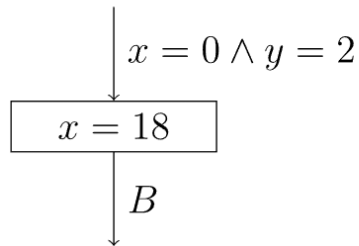
3.



5.



2.



4.



6.



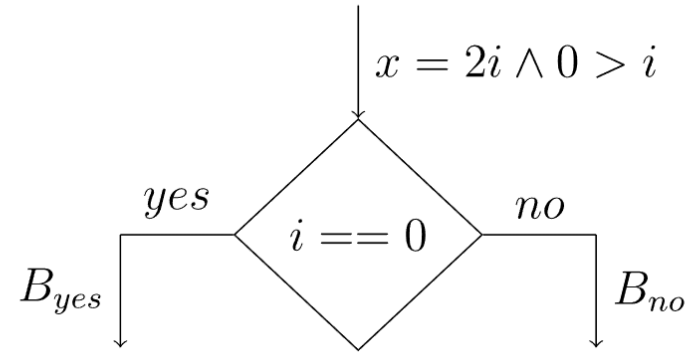


## T04: Strongest Postconditions 2

7.



8.



## T04: Strongest Postconditions 3

9.

