

*sisotool(obiekt\_lti)*

*obiekt\_lti = model obiektu (bez regulatora)*

*sisotool(obiekt\_lti, regulator)*

## SISO Design (obiekt LTI)

4.1) SISO Design

- struktura

układu regulacji

The screenshot shows the MATLAB Control and Estimation Tools Manager interface. The 'Architecture' tab is selected, and the 'Control Architecture' dialog box is open. The dialog displays a block diagram of a control system with blocks F, C, G, and H. The dialog also shows a table for defining signal signs.

Identifier	Sign
S1	-1

# SISO Design (obiekt LTI)

## 4.1) SISO Design - typ regulatora

Control and Estimation Tools Manager

File Edit Help

Workspace

- SISO Design Task
- Design History

Architecture | Compensator Editor | Graphical Tuning | Analysis Plots | Automated Tuning

Current Architecture:

Control Architecture ... Modify architecture, labels and feedback signs.

Loop Configuration... Configure additional loop openings for multi-loop design.

System Data ... Import data for compensators and fixed systems.

Change the sample time of the design.

Change the nominal plant and multimodel options.

System Data

Import Model

System	Data
G	< Current Value >
H	1
C	< regPI >
F	1

*zaimportowany*

Model Import

Import model for: C

Import from:

- Workspace
- MAT File:  Browse ...

Available Models	Type	Order
regPI	tf	1
s	tf	2

$regPI = 1 + 1/(2*s)$

Import Close Help

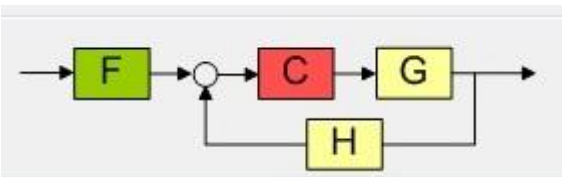
System Data

Import Model

System	Data
G	< Current Value >
H	1
C	1
F	1

*domyślny*

Browse ...



# SISO Design (obiekt LTI)

## 4.2) SISO Design - regulator

Control and Estimation Tools Manager

File Edit Help

Architecture **Compensator Editor** Graphical Tuning Analysis Plots Automated Tuning

Compensator

C = 1

*regulator P  
(domyślny)*

Pole/Zero Parameter

Dynamics Edit Selected Dynamics

Workspace

- SISO Design Task
- Design History

Control and Estimation Tools Manager

File Edit Help

Architecture Compensator Editor Graphical Tuning Analysis Plots Automated Tuning

Compensator

C = 0.5  $\times \frac{(1 + 2s)}{s}$

*regulator PI  
(zaimportowany)  
regPI=1+1/(2\*s)*

Pole/Zero Parameter

Dynamics

Type	Location	Damping	Frequency
Real Zero	-0.5	1	0.5
Integrator	0	-1	0

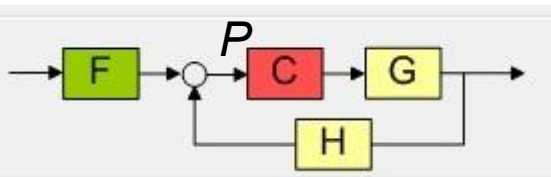
Right-click

Workspace

- SISO Design Task
- Design History

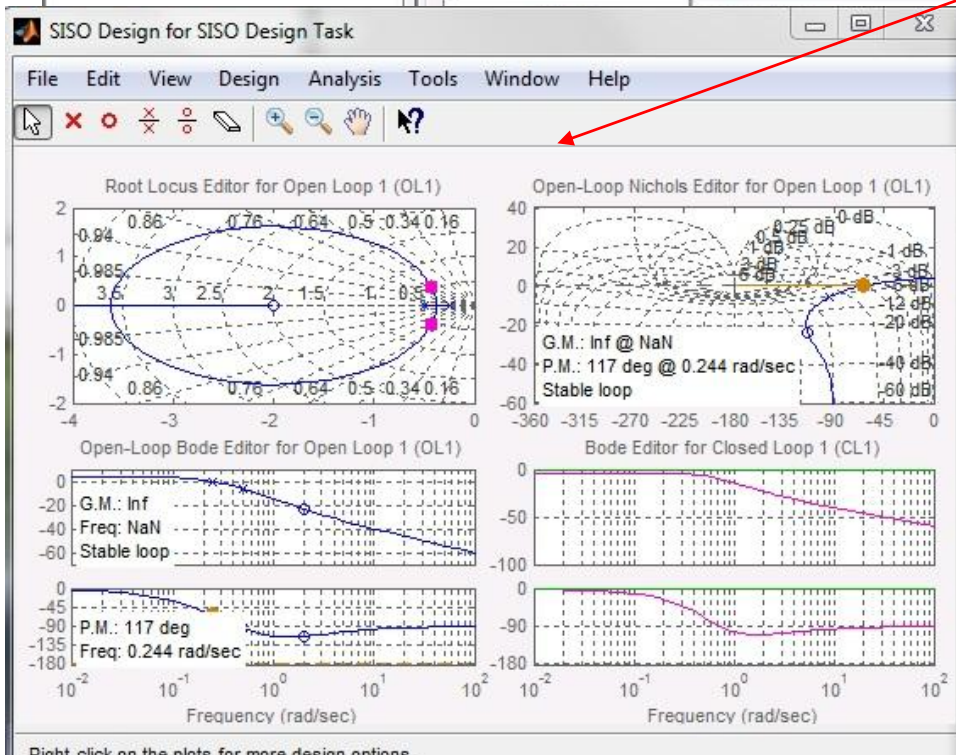
# SISO Design (obiekt LTI)

## 4.3) SISO Design - projektowanie



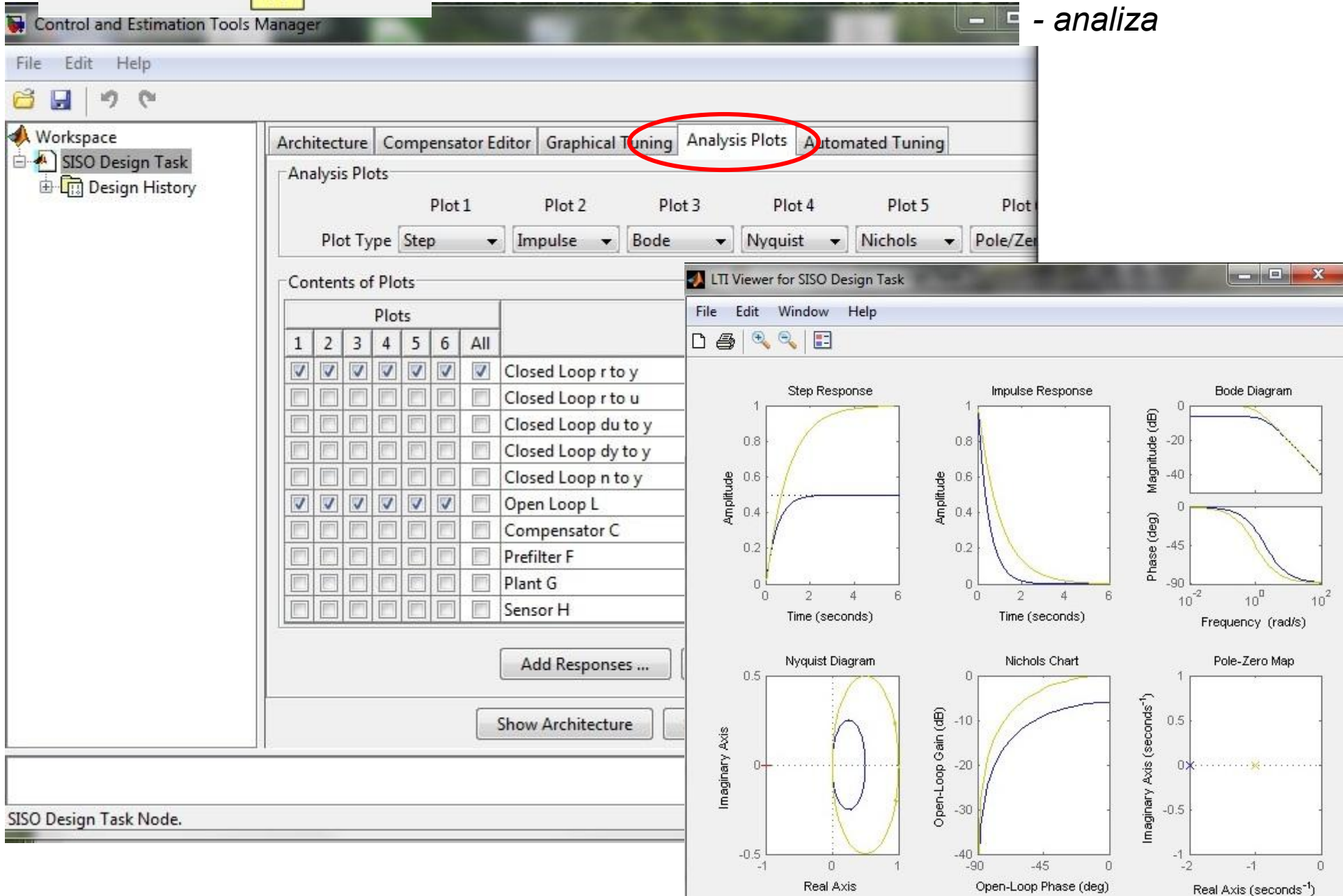
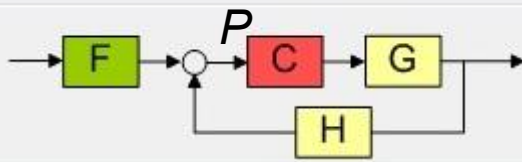
Plot	Available Open/Closed Loop to Tune	Plot Type
Plot 1	Open Loop 1	Root Locus
Plot 2	Open Loop 1	Open-Loop Bode
Plot 3	Open Loop 1	Nichols
Plot 4	Closed Loop 1	Closed-Loop B...
		None

- linie pierwiastkowe
- Bode ukł. otwartego
- Nichols ukł. otwartego
- Bode ukł. zamkniętego



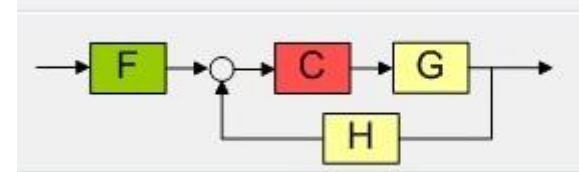
# SISO Design (obiekt LTI)

## 4.4) SISO Design - analiza

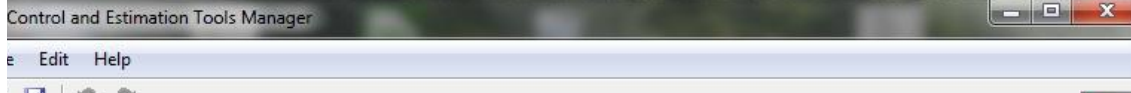
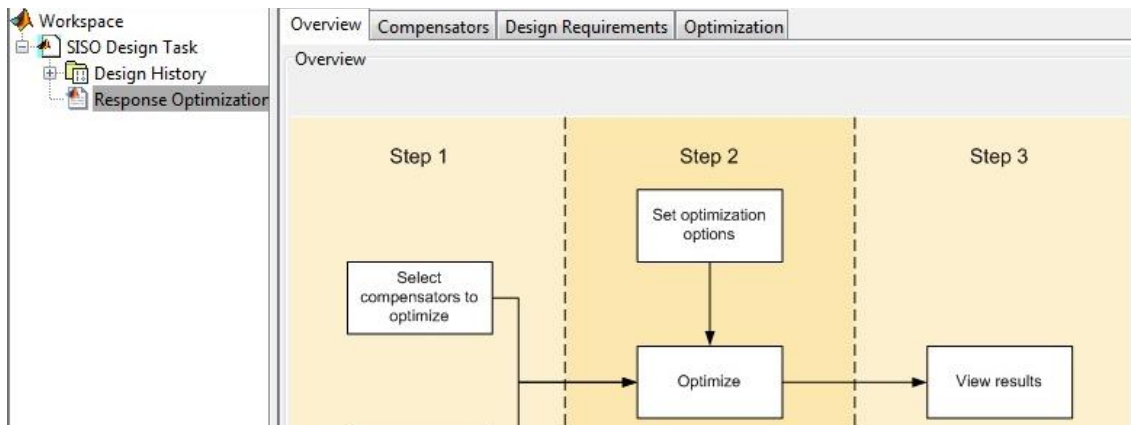


# Design (obiekt LTI)

## 5.1) SISO Design (strojenie) Optimization Based Tuning

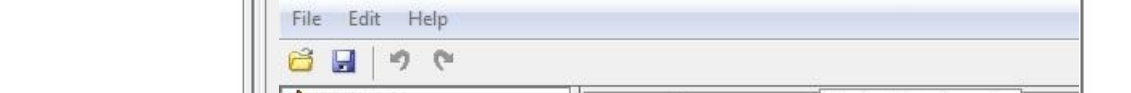


Wymaga:  
Simulink Design Optimization



Select compensators to optimize

Opti...	Compensator elements	Value	Initial gu...	Minimum	Maximum	Typi...
<input checked="" type="checkbox"/>	C					
<input checked="" type="checkbox"/>	Gain	1	1	-Inf	Inf	
<input type="checkbox"/>	F					



Select design requirement to satisfy

Opti...	Response plot
<input type="checkbox"/>	Closed Loop r to y
<input checked="" type="checkbox"/>	Step Response

New Design Requirement

Design requirement type:

Requirement for response:

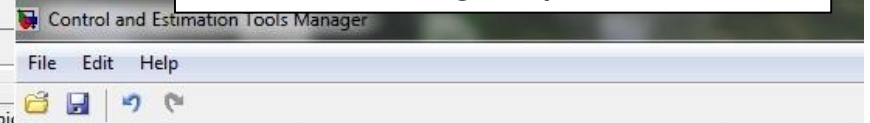
Design requirement parameters

Initial value:

Step time:  seconds

Rise time:  seconds % Rise:

Settling time:  seconds % Settling:



Optimization Progress

Iteration	Eval-Cou...	Cost fun...	Constrai...	Step size	Pro
0	3	0	0.49		
1	6	0	0.2425	1.96	
2	9	0	0.1188	3.8	
3	12	0	0.05701	7.16	
4	15	0	0.02621	12.7	
5	18	0	0.011	20	
6	21	0	0.003783	24.9	
7	24	0	0.0008146	19.9	

Constructing optimization problem...  
Optimization started 16-Apr-2013 16:10:00  
Optimization finished 16-Apr-2013 16:10:09  
Successful termination.  
Found a feasible or optimal solution within the specified tolerances.

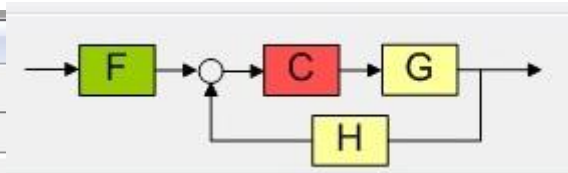
Response Optimization

Start Optimization

# SISO Design (obiekt LTI)

## 5.2) SISO Design (strojenie) PID Tuning

The screenshot shows the 'Control and Estimation Tools Manager' window. The 'Workspace' on the left contains 'SISO Design Task', 'Design History', and 'Response Optimization'. The main panel has tabs for 'Architecture', 'Compensator Editor', 'Graphical Tuning', 'Analysis Plots', and 'Automated Tuning'. The 'Design method' is set to 'PID Tuning'. The 'Compensator' is 'C' with a value of 91.467. Under 'Specifications', the 'Tuning method' is 'Robust response time' (circled in red). 'Design options' include 'Controller Type' (PI selected), 'Design with first order derivative filter' (checked), and 'Design mode' (Interactive selected). 'Bandwidth' is 1.12 rad/s and 'Phase margin' is 60 deg. Buttons at the bottom include 'Update Compensator', 'Show Architecture', 'Store Design', and 'Help'. The status bar at the bottom reads 'SISO Design Task Node.'



# SISO Design (obiekt LTI)

## 5.2 SISO Design (strojenie) PID Tuning

Control and Estimation Tools Manager

File Edit Help

Workspace

- SISO Design Task
  - Design History
  - Response Optimizer

Architecture Compensator Editor Graphical Tuning Analysis Plots Automated Tuning

Design method: PID Tuning

Compensator

C = 91.467

Specifications

Tuning method: Classical design formulas

Design options

Controller Type:  P  PI  PID  PID with derivative filter

Formula:

- Approximate MIGO frequency response
- Approximate MIGO step response
- Chien-Hrones-Reswick
- Skogestad IMC
- Ziegler-Nichols frequency response
- Ziegler-Nichols step response

Update Compensator

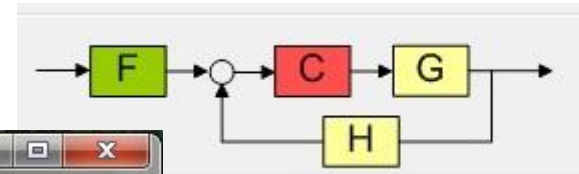
Show Architecture Store Design Help

SISO Design Task Node.



# SISO Design (obiekt LTI)

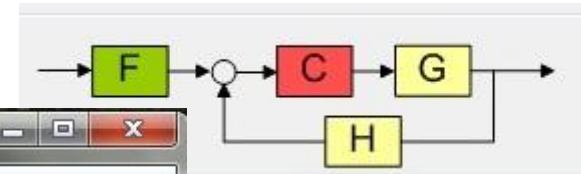
## 5.3 SISO Design (strojenie) IMC Tuning



The screenshot shows the 'Control and Estimation Tools Manager' software interface. The window title is 'Control and Estimation Tools Manager'. The menu bar includes 'File', 'Edit', and 'Help'. The toolbar contains icons for file operations and navigation. The 'Workspace' pane on the left shows a tree view with 'SISO Design Task', 'Design History', and 'Response Optimization'. The main workspace has several tabs: 'Architecture', 'Compensator Editor', 'Graphical Tuning', 'Analysis Plots', and 'Automated Tuning'. The 'Automated Tuning' tab is active, showing the 'Design method' set to 'Internal Model Control (IMC) Tuning'. Under 'Compensator', a dropdown menu shows 'C' with a value of '= 91.467'. The 'Specifications' section includes 'Dominant closed-loop time constant' set to '0.19562' and 'Desired controller order' with a slider between 1 and 2, currently set to 2. At the bottom right of the main workspace is an 'Update Compensator' button. At the bottom of the window are three buttons: 'Show Architecture', 'Store Design', and 'Help'. The status bar at the bottom left reads 'SISO Design Task Node.'

# SISO Design (obiekt LTI)

## 5.4 SISO Design (strojenie) LQG Synthesis



Control and Estimation Tools Manager

File Edit Help

Workspace

- SISO Design Task
  - Design History
  - Response Optimization

Architecture Compensator Editor Graphical Tuning Analysis Plots Automated Tuning

Design method: LQG Synthesis

Compensator

C = 91.467

Specifications

Controller response: Aggressive Robust

Measurement noise: Small Large

Desired controller order: 1 2 2

Update Compensator

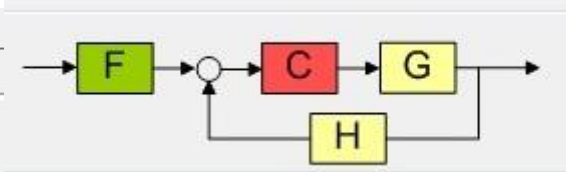
Show Architecture Store Design Help

SISO Design Task Node.

# SISO Design (obiekt LTI)

## 5.5 SISO Design (strojenie) Loop Shaping

The screenshot shows the 'Control and Estimation Tools Manager' window. The 'Workspace' on the left contains a 'SISO Design Task' with sub-items 'Design History' and 'Response Optimization'. The main panel has tabs for 'Architecture', 'Compensator Editor', 'Graphical Tuning', 'Analysis Plots', and 'Automated Tuning'. The 'Design method' is set to 'Loop Shaping'. Under 'Compensator', a dropdown menu shows 'C' with a value of '= 91.467'. The 'Specifications' section has 'Tuning preference' with 'Target bandwidth' selected. Below it, 'Target open-loop bandwidth' is set to '10' and 'Desired controller order' is set to '3'. An 'Update Compensator' button is at the bottom right.



*Wymaga:  
Robust Control Toolbox*

This close-up shows the 'Target loop shape' configuration options. The 'Tuning preference' is now 'Target loop shape' (selected). The 'Target open-loop shape (LTI)' is set to 'tf(1,[1,1])'. The 'Frequency range for loop shaping [wmin,wmax]' is set to '[0,inf]'. The 'Desired controller order' is still set to '3'.

Zastosowanie:

- definicja modelu obiektu (LTI)
- definicja:
  - wybór układu regulacji (architektura),
  - wybór typu regulatora
- automatyczny dobór nastaw
  - wybór metody (ograniczenia)
- strojenie graficzne (optymalizacja)