Gliwice, 22.01.2023r.

Fundamentals and implementations of modeling and simulations.

Documentation of laboratory task no 8.

Title: Distribution of temperature in a bar

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Field of studies: Informatics (sem.V)

Project Objective:

Goal of the task is to determine the distribution of temperature in the assumed domain for the given initial and boundary conditions.

Description:

Sun is the ultimate source of heat. And the differential heat received from sun by different regions on earth is the ultimate reason behind all climatic features. So understanding the patterns of distribution of temperature in different seasons is important for understanding various climatic features like wind systems, pressure systems, precipitation etc.

The distribution of temperature across latitude over the Earth's surface is known as the horizontal distribution of temperatures. The horizontal distribution of temperature on Earth is shown by Isotherms. Isotherms are the line joining points that have an equal temperature. When the isotherm map is analyzed, it can be observed that the horizontal distribution of temperature is uneven.

As we are aware, the temperature in the troposphere decreases with an increase in altitudes but the rate of decrease in the temperature changes according to seasons. The decrease of temperatures is known as the vertical temperature gradient or normal lapse rate which is 1000 times more than the horizontal lapse rate. The decrease of temperature upward in the atmosphere proves the fact that the atmosphere gets heat from the Earth's surface through the process of conduction, radiation, and convection. Hence, as the distance from the Earth's surface (the source of direct heat energy to the atmosphere) increases (i.e as the altitude increases), the air temperature decreases.

Distribution of temperaturę u(x,t) in warmed or cooled bar is described by means of the following partial differential equation

$$\frac{\partial u(x,t)}{\partial t} = k\,\frac{\partial^2 u(x,t)}{\partial x^2} \quad \text{for} \quad x \in [a,b],\ t \in [0,t^*],$$

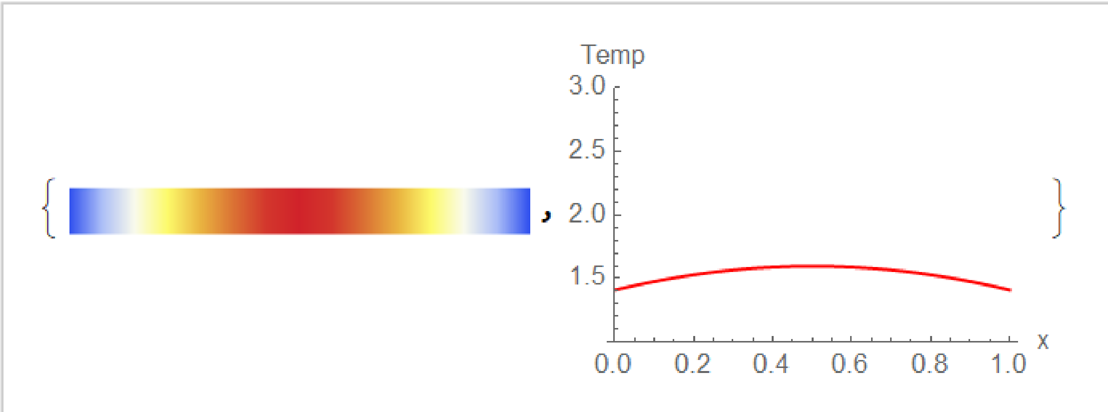
Where x is the spatial variable, t is the time variable and k = λ/cρ denotes the cooeficient depending on material, the bar is made of (λ-thermal conductivity coefficient, c-specific heat, ρ-density). The above equation is completed by the boundary conditions

$$u(a,t) = \alpha(t),\ u(b,t) = \beta(t) \quad \text{for} \quad t \in [0,t^*],$$

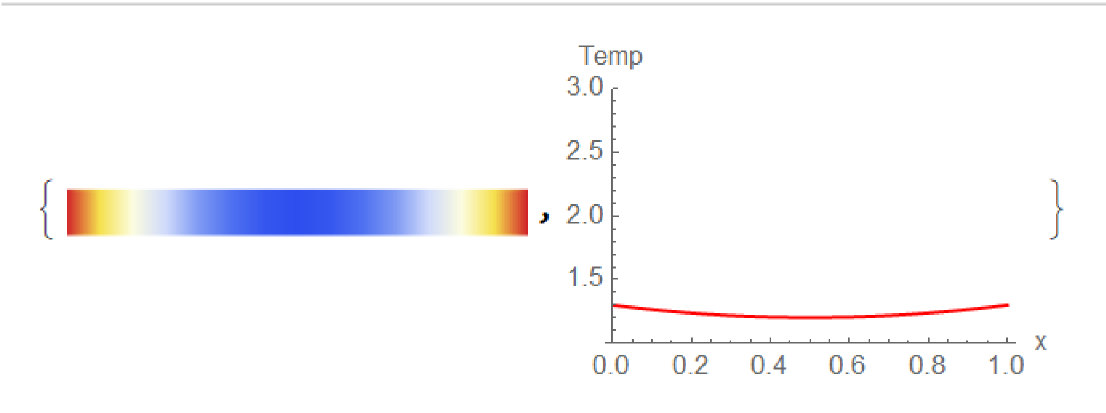
and the initial condition

$$u(x,0) = \phi(x) \quad \text{for} \quad x \in [a,b].$$

Solutions to exemplary tasks:



1.



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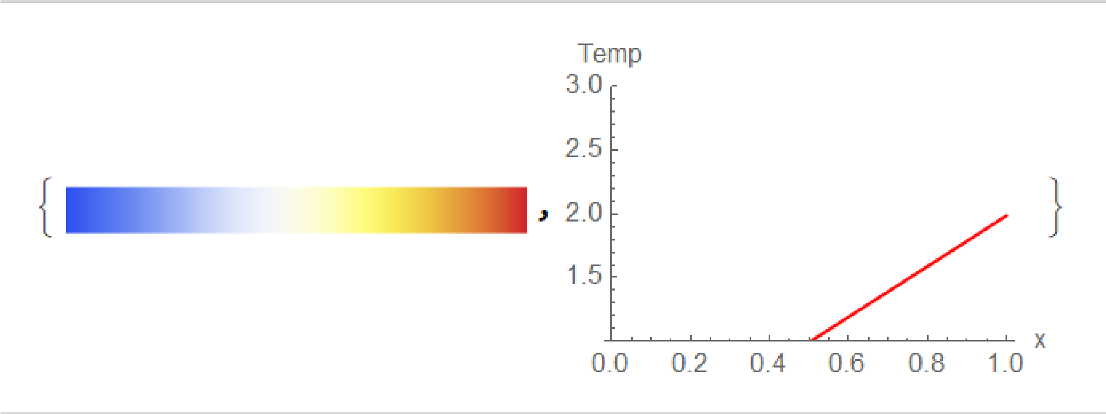
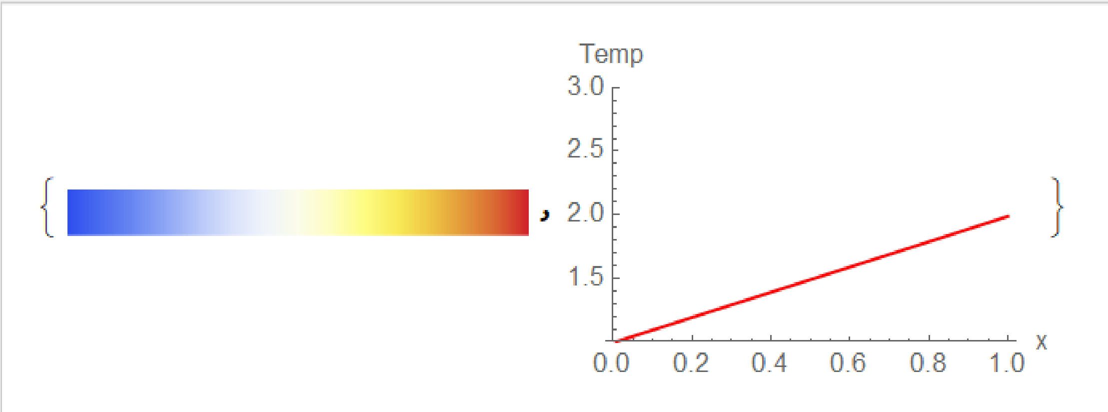
3. 

4. 

Enclosures:

File with the program(Łukaszek_Artur_proj_8.nb)