

Assignment in Computer Graphics II

– Assignment 1 –

Computer Graphics and Multimedia Systems Group

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Assignment 1 [2 Points] Calculus

a) Given the following polynomial of degree three

$$f(x) = 2x^3 + 6x^2 - 8.$$

- Determine the domain \mathbb{D} for polynomial f .
- How does f behave at the boundaries of \mathbb{D} .
- Determine the roots of f .
(**Hint:** Guess the first root and compute further roots analytically.)
- Where are the turning points of polynomial f ? Determine for each turning point if it is a minimum or a maximum.
- What is the geometrical meaning of the first derivative of a function.

b) Given the following functions

$$g(x) = \cos(x^2 - 1)$$

$$h(x) = -\sin(x) \cdot x^3$$

$$i(x) = 6x^2 + 4.$$

- What are the derivatives of functions g and h .
- What is the antiderivative of i .
- Evaluate the following integral

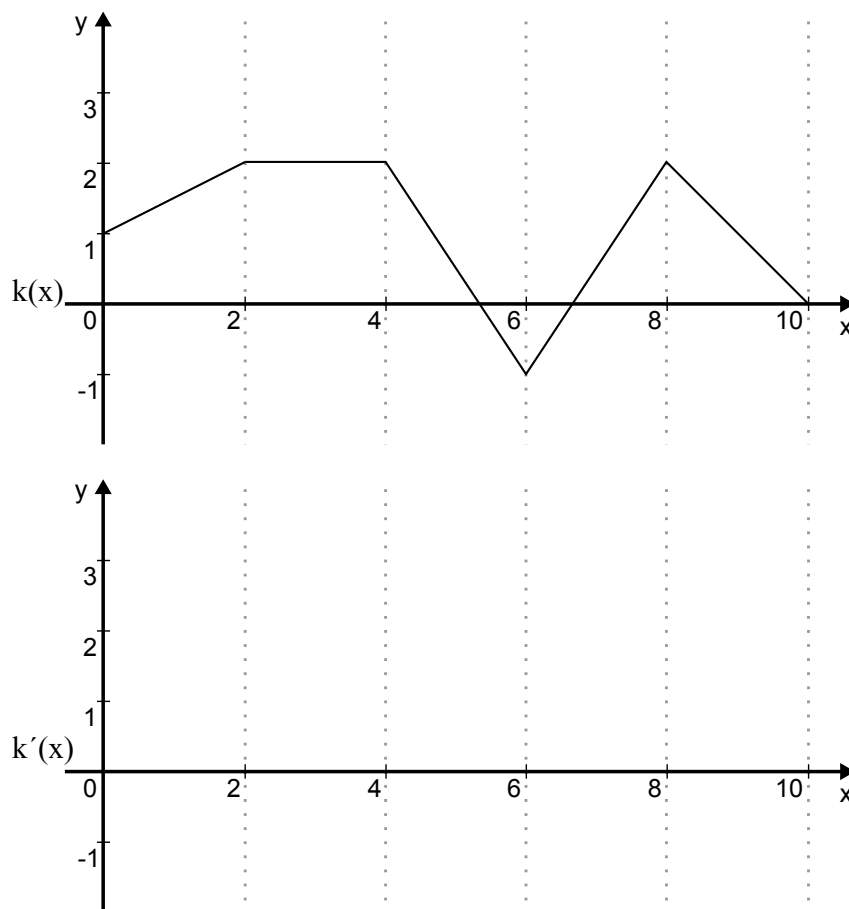
$$\int_0^5 i(x) dx$$

c) Give the rational function

$$j(x) = \frac{1}{x-1}$$

- Give the domain \mathbb{D} of function j .
- How does j behave at the boundaries of \mathbb{D} .
- Discuss the continuity of j .

d) Draw the first derivative of $k(x)$.



Assignment 2 [2 Points] analytic geometry (repetition)

a) Given the points $P = (2, 1, 5)$ and $Q = (4, -1, 0)$ in \mathbb{R}^3 .

- Determine the parametric line equation of form $\vec{g}(t) = \vec{p} + t\vec{u}$, so that the straight line \vec{g} passes through the points P and Q .
- Determine the distance of point $R = (2, -2, 4)$ to the line \vec{g} ?

b) Consider the plane e of the form $\vec{e}(s, t) = \vec{p} + s \cdot \vec{u} + t \cdot \vec{v}$ in \mathbb{R}^3 with the vectors $\vec{p} = (3, 2, 1)^T$, $\vec{u} = (2, 0, 1)^T$ and $\vec{v} = (1, 3, 3)^T$

- Determine the normal vector \vec{n} , which is orthogonal to the plane of e .
- Show that the normal vector \vec{n} is really orthogonal to the vectors \vec{u} and \vec{v} .

Assignment 3 [2 Points] Curve and surface discussion

Given the following curve $C(t) = \begin{pmatrix} t \cos(2\pi t) \\ t \sin(2\pi t) \end{pmatrix}$ with parameter $t \in \mathbb{R}$

- Determine its derivative $C'(t)$.
- Determine its tangent vector and normal at $t = 0, 0.125, 0.25, 0.5, 1.0$.

Given the following surface $S(u, v) = \begin{pmatrix} u \\ v \\ v^2 \cos(u) \end{pmatrix}$ with parameters $(u, v) \in \mathbb{R}^2$

- Determine its partial derivatives $S'_u(u, v)$ and $S'_v(u, v)$.
- Determine a general formulation for the normal $\vec{n}(u, v)$.

Assignment 4 [2 Points] Complex Numbers (Bonus task)

Calculate:

- the difference of $2 - 2i$ and $6 - i$.
- the product of $2 - 3i$ and $5 + 4i$.
- the quotient of $2 - 5i$ and $3 + 7i$.

Hand in: 26.04.2017 12:00, in the mailbox of the chair (next to room H-A 7107)