Assignment in Computer Graphics II

– Assignment 1 –

Computer Graphics and
Multimedia Systems Group
Markus Kluge, Dmitri Presnov, Jan Mußmann

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

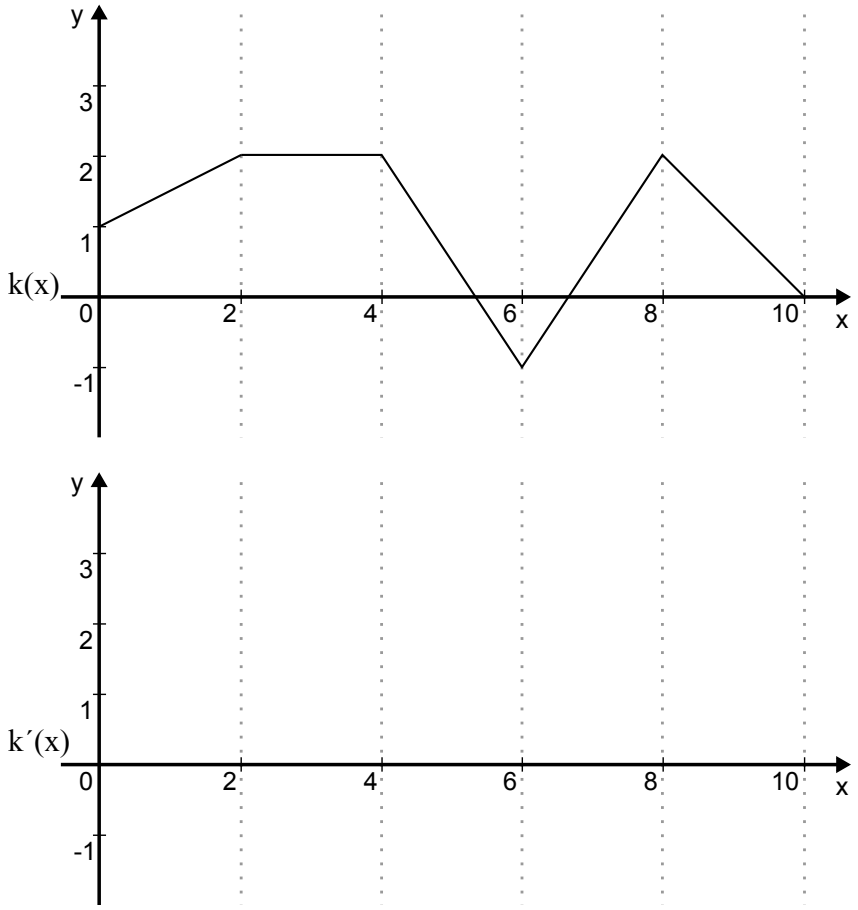
$$\int_0^5 i(x)dx$$

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 paramter $t \in \mathbb{R}$

- 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 $S'_v(u,v)$.
- Deterime 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: 11.04.2019 10:00, in the mailbox of the chair (next to room H-A 7115)