Creating large-scale virtual environments for interactive applications such as computer games poses a demanding challenge for computer graphics. Urban environments are usually hand-crafted by artists using commercial 3D modeling software. For today's detail-rich games, this process becomes less and less feasible.

In this thesis, a system is presented that helps artists and game designers to plan, layout and model urban environments for games and other media by employing procedural modeling techniques.

**Planning and Layout**
- Terrain can be generated from a heightmap image
- Area and gameplay maps are projected onto terrain
- Points of interest (e.g. mission targets) can be denoted using markers
- Interactive street sketching

**Building Assignments**
Buildings automatically assigned to parcels from a set of previously modeled buildings.
Algorithm chooses building that occupies most of a parcel, while satisfying the following constraints:
- Building is completely contained in parcel
- Sides with doors face a street
- Plain brick walls or backyards do not face a street

Algorithm:
1. Building is placed on parcel center
2. Largest street access side is aligned with street
3. Building is rotated until all conditions met
4. And moved near the streets
If any of the constraints is violated, process is repeated with the next smaller building.

**Main Limitations in Previous Systems**
- No tools available for artists to plan virtual cities
- Procedurally created street networks: Minor roads are created inside quarters surrounded by major roads → sparse regions at city outskirts
- No tessellated street geometry that is able to connect many street segments and dynamically adapts to terrain
- Not possible to interactively edit the street network and street geometry
- Buildings have to be placed manually at their positions

**City Hierarchy Definition**

**Street Network Creation**
Automatic process guided by city hierarchy:
- Major roads created first using L-Systems
- New contribution: Bulged convex hull forms city boundary to create quarters at outer city regions and fill them with minor roads
- Blocks are split into parcels

**Street Network Editing**
User can directly edit street geometry:
- Add and remove streets interactively
- Street segments, parcels and buildings are updated automatically when junctions are moved

**Street Geometry**
- New polygonal street representation that allows junctions to connect an arbitrary number of segments
- Street geometry adapts to underlying terrain
- Textured to make it visually appealing