

# Künstliche Intelligenz in Spielen

WAP - Gruppe 3

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# Übersicht

- 1 Was ist KI/KI in Spielen
- 2 Testen von KI/KI in Spielen
- 3 Neuroevolution
- 4 KI in MMORPGs

# Was ist Künstliche Intelligenz?

# Was ist Künstliche Intelligenz?

- “The automation of activities that we associate with human thinking, activities such as decision-making, problem solving, learning...” (Bellman, 1978)
- “The study of mental faculties through the use of computational models” (Charniak and McDermott, 1985)
- “The art of creating machines that perform functions that require intelligence when performed by people” (Kurzweil, 1990)
- “A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes” (Schalkoff, 1990)

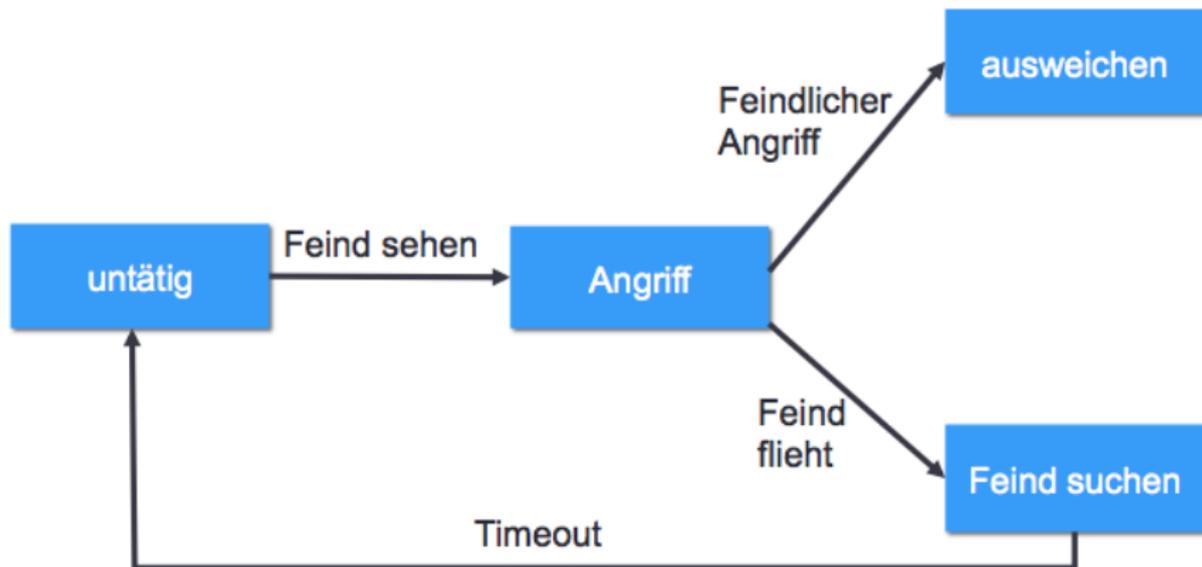
# Warum KI in Spielen?

- Computergesteuerte Spieler
- Verschiedene Anforderungen
  - Einzelcharakter vs. Gruppen
  - Alliierte vs. Gegner
  - vorgefertigte Levels vs. zufallsgenerierte Karten
  - rundenbasiert vs. Echtzeit

# Beispiele Realisierungsmethoden

- Expertensysteme
- Fallbasiertes Schließen
- Endliche Automaten
- Regel- und Produktionssystem
- Suchmethoden
- Schwarmverhalten
- Evolutionäre Algorithmen
- Neuronale Netze

# Endlicher Automat



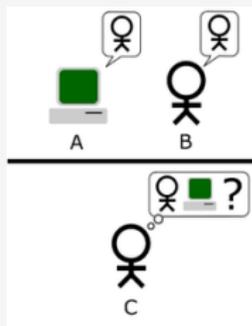
# Was ist bei KI in Spielen anders?

- Ziel der KI-Forschung
  - Perfektion
- Ziel der KI in Spielen
  - richtige Lösung
  - Glaubwürdigkeit
  - Unterhaltung
  - Beschränkte Ressourcen

Wie testet man KI?

Wie testet man KI in Spielen?

# Wie testet man KI



## Turing Test:

Hat eine Maschine ein dem Menschen gleichwertiges Denkvermögen?

## Kritik:

Gedankenexperiment von John Searle (Das chinesische Zimmer)



## Wie testet man KI in Spielen

### 2K Botprize:

Turing Test für KI in Spielen



### Ziel:

Computergesteuerte Gegner agieren wie "echte" Menschen

### Preis:

\$7000 und eine Reise zu den 2K Marin's Canberra Studios in Australien

## 2K Botprize:

### Ablauf:

Menschliche Spieler, Bots und eine Jury spielen UnrealTournament2004 gegeneinander.

Jury markiert alle Spieler als "Bot" oder "Mensch"

Der Bot der am Ende eine höhere Menschlichkeitsrate als die durchschnittliche Menschlichkeitsrate der menschlichen Spieler erreicht, gewinnt.

## 2K Botprize:

2012:

Mirror Bot von Mihai Polcenau erreicht 52,2% Menschlichkeit.

UT<sup>2</sup> vom UT<sup>2</sup> Team (Jacob Schrumm, Igor Karpov, Risto Mikkulainen) erreicht 51,9% Menschlichkeit.

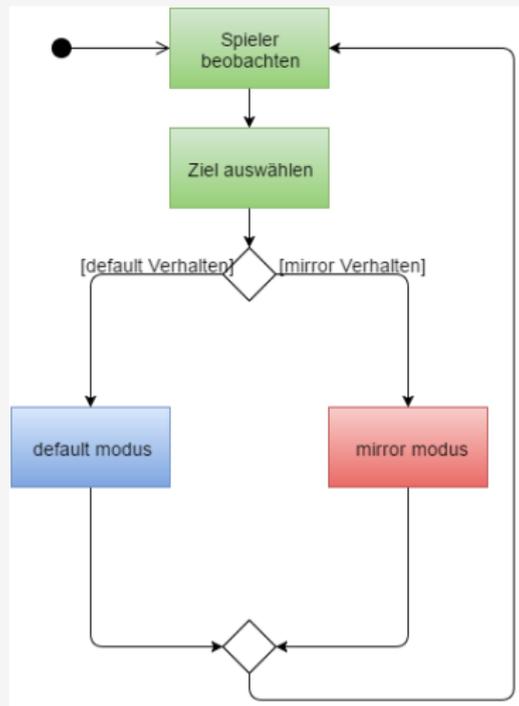
# Mirror Bot:

## Idee:

Ahmt Gegner nach und dadurch auch dessen Menschlichkeitsrate.

## Verhalten:

- 1 Beobachte Spieler
- 2 Wähle Ziel
- 3 Wähle Verhalten





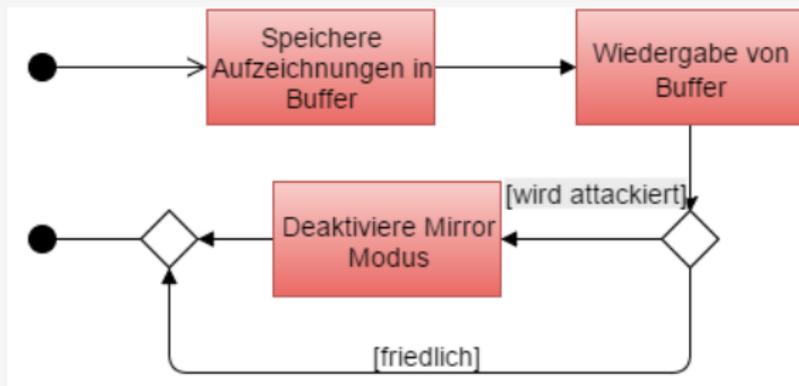
# Mirror Bot:

## Mirror Modus:

Wird nur gegenüber freundlich gesinnten Spielern aktiviert.

Problem:

Ahmt auch andere Bots nach.



# Neuroevolution

# Fragen

- Was ist Neuroevolution?
- Wie funktioniert sie?

# Was ist Neuroevolution?

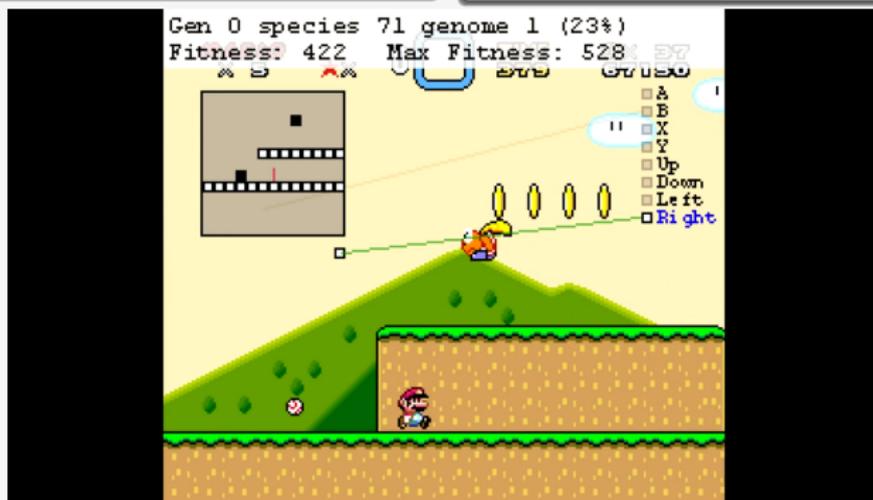
- Eigenständiges Lernen von Maschinen.
- Evolutionäre Algorithmen kommen zum Einsatz.
- Sehr stark an die natürliche Selektion angelehnt.

# Wie funktioniert dieses Verfahren?

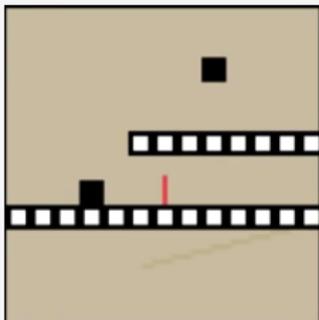
## Beispiel:

Super Mario Level durchspielen ohne vorher zu wissen wie das Spiel funktioniert.

Das Programm bringt sich selbst bei, wie es ein solches Level bestehen kann ohne dabei zu sterben.

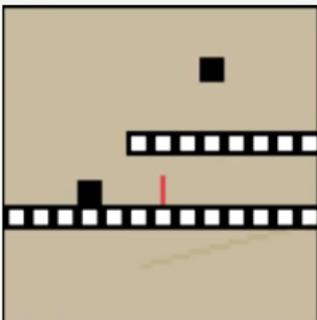


# Wie funktioniert dieses Verfahren?

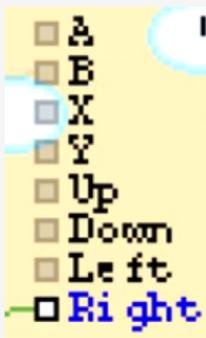


Weiß/Schwarze Blöcke stehen für den Input.

# Wie funktioniert dieses Verfahren?



Weiß/Schwarze Blöcke stehen für den Input.



Knöpfe eines SNES- Controllers sind unser Output.



# Wie funktioniert dieses Verfahren?



Netzwerk von Verbindungen, das den Input mit dem Output verbindet.

# Wie funktioniert dieses Verfahren?

- Anfang bei Generation 0.
- Ungefähr 100 Durchläufe.
- Jeder Durchlauf repräsentiert ein Individuum, das sich von allen anderen Durchgängen unterscheidet.
- Das Programm probiert Verschiedenes aus.
- Es erstellt erstmal durch Zufall einfache Verbindungen.

# Wie funktioniert dieses Verfahren?

- Jeder Durchlauf wird abgespeichert und auch dessen Fortschritt.
  - Fortschritt = Wie weit und wie schnell der Spieler nach rechts läuft.

## Wie funktioniert dieses Verfahren?

- Wenn die 1. Generation ganz durchsimuliert wurde, beginnt die nächste.
- Die Durchläufe mit dem größten Fortschritt werden kombiniert oder leicht verändert.
- Dies soll Mutationen darstellen, um durch Zufall wieder etwas Neues und vielleicht sogar Brauchbares zu entwickeln.

# Wie funktioniert dieses Verfahren?

- Dieser Vorgang wiederholt sich so oft, bis der Computer ein ganzes Level ohne zu sterben durchspielen kann.
- Dadurch entstehen ziemlich komplexe Netzwerke.
- Nicht vom Menschen direkt erstellt.



# Zusammenfassend

## Negatives:

- Es braucht mehrere Versuche  
=> keine direkte Lösung  
möglich
- Erste Lösung ist nicht  
unbedingt die  
schönste/effektivste

## Positives:

- Unterschiedliche Lösungen  
können gefunden werden
- Große Fläche an Möglichkeiten  
abdecken
- Der Programmierer muss  
nichts am Code ändern

# KI in [MMO]RPGs

# KI in [MMO]RPGs

MMORPG

Herausforderungen

Lösungsansatz

# [MMO]RPG

## RPG (Role-Playing-Game)



VS



non-Player Character

Player

Monster

## MMO[RPG]

- Massively multiplayer online
- hunderte/tausende Spieler auf einem Game-Server

# Herausforderungen

## Herausforderungen

- Persistent World == Static World?
  - statische NPCs
  - statischer Content
    - ⇒ nächster Spieler, der vorbeikommt "erlebt" dieselbe Story
- "belebte" Spielwelt Möglich?

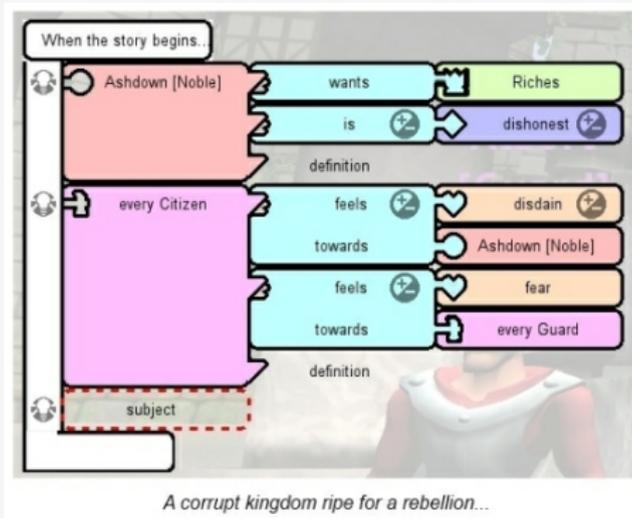
# Lösungsansatz

## Automatisch Generierter Content

- "intelligente" NPCs.
  - Gruppen/Fraktionen mit eigenständigen Motivationen.
- ⇒ NPCs stehen nicht herum und warten auf einen (weiteren) Spieler der ihnen hilft, sondern haben eigene Bedürfnisse, die sie versuchen selbst zu befriedigen.

# NPCs

- Designer legt generelle Eigenschaften und Bedürfnisse eines NPCs fest.
- Zusätzliche zufällige Attribute wie Ehrlichkeit, Gier, Geiz, "Nächstenliebe"...



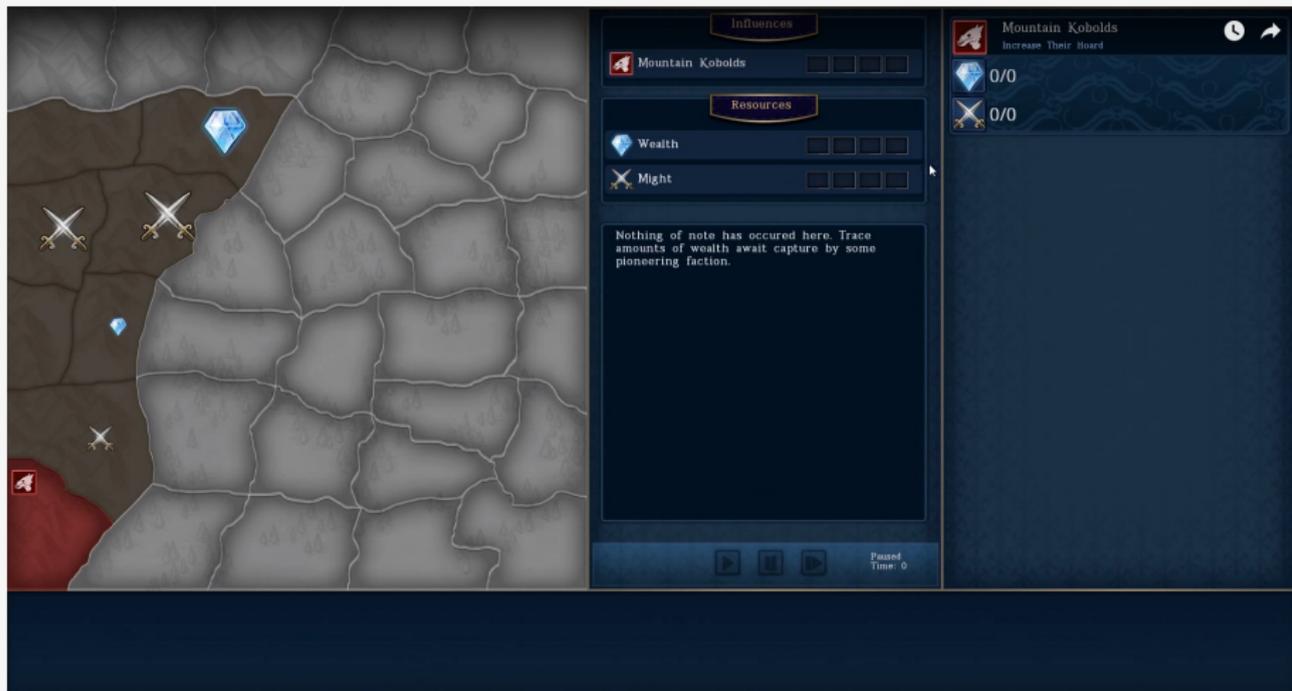
# Gruppen/Fraktionen

Motivation einer Gruppe von NPCs vom Designer festgelegt.

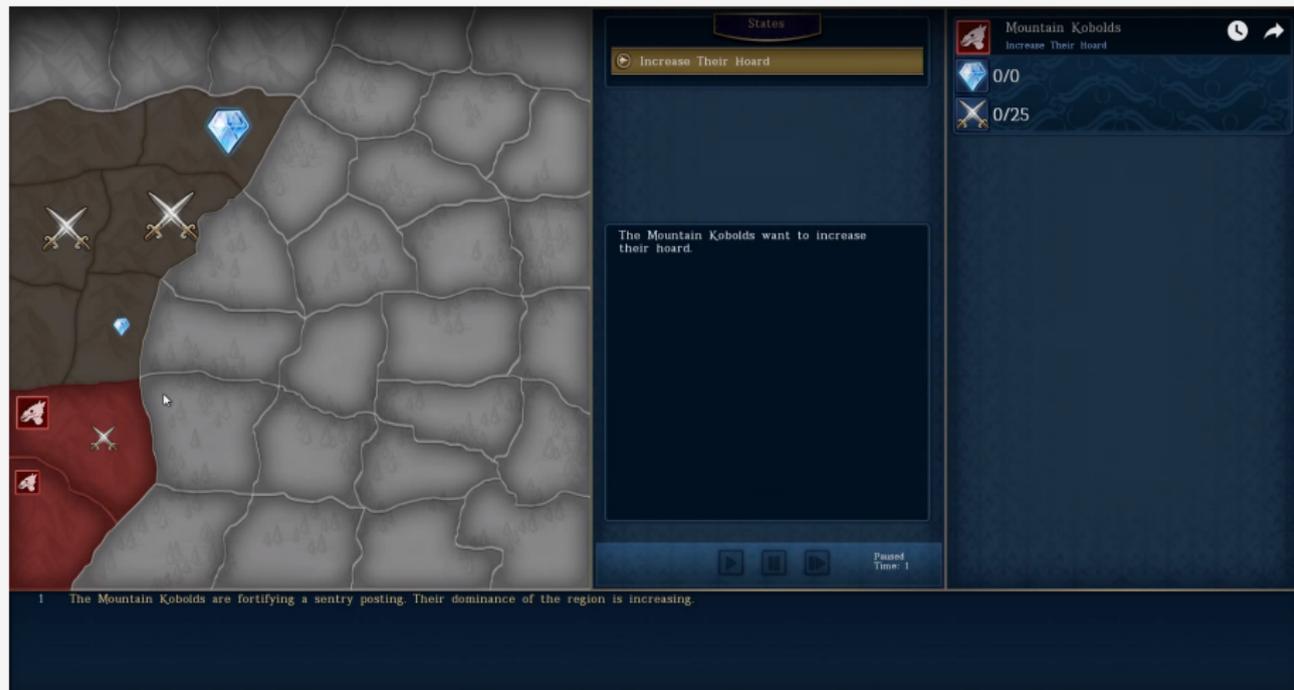
z.B.

- sichere Zuflucht
- mehr Reichtum
- Expansion des kontrollierten Gebietes
- Vernichtung von Feinden
- usw.

## Demo



## Demo



The screenshot displays a game interface with three main sections:

- Map:** A top-down view of a terrain with grey and brown hexagonal cells. A red region is visible on the left, containing a sentry post icon (a crossed sword) and a Mountain Kobold unit icon. A blue diamond resource is located in the upper left.
- Mission Log:** A central panel titled "States" with a sub-header "Increase Their Hoard". It contains the text: "The Mountain Kobolds want to increase their hoard." At the bottom right of this panel, it says "Paused Time: 1".
- Unit Status Panel:** A panel on the right titled "Mountain Kobolds" with the sub-header "Increase Their Hoard". It shows two resource counters: a blue diamond icon with "0/0" and a crossed sword icon with "0/25".

At the bottom of the screen, a text box contains the following text:

1 The Mountain Kobolds are fortifying a sentry posting. Their dominance of the region is increasing.

## Demo

The screenshot displays a game interface with a map on the left, a central panel, and a right-side mission panel.

**Map:** Shows a terrain with a red region on the left. A blue diamond icon is located in the upper right area of the map. Two crossed swords icons are positioned in the middle-left area.

**Central Panel:**

- Influences:** Mountain Kobolds (represented by a red kobold icon) has a progress bar with 4 segments, 3 of which are filled.
- Resources:**
  - Wealth (represented by a blue diamond icon) has a progress bar with 4 segments, 3 of which are filled.
  - Might (represented by crossed swords icon) has a progress bar with 4 segments, 3 of which are filled.
- Text:** "Just recently, this territory was filled with all kinds of trinkets. The wealth mining operations are deserted. There are no resources here."
- Buttons:** Play, Stop, and Fast Forward icons are visible at the bottom of the panel.
- Timer:** "Paused Time: 4"

**Right Panel:**

- Header:** Mountain Kobolds (with kobold icon), Increase Their Hoard (with share icon).
- Progress:**
  - Wealth: 20/0 (with diamond icon)
  - Might: 0/25 (with crossed swords icon)

**Mission Log (Bottom):**

- 2 The Mountain Kobolds are building a new outpost. Their dominance of the region is ever-increasing.
- 3 The Mountain Kobolds are carving out darklight gems, working steadily to increase their hoard. Their hoard of wealth grows even greater.
- 4 The Mountain Kobolds are smashing open crystal clutches, working steadily to increase their hoard. Their cache of materials grows even greater.

## Demo

The screenshot displays a game interface with a map on the left, a province information panel in the center, and a log of events at the bottom.

**Map:** A map showing a province (Mountain Kobolds) in red, surrounded by grey terrain. The province contains several icons: a red square with a white 'A', a red square with a white 'X', and a red square with a white 'X' and a red square with a white 'A'.

**Province Information Panel:**

- Influences:** Mountain Kobolds (represented by a red square with a white 'A') with a progress bar showing 3 out of 4 segments.
- Resources:**
  - Wealth (represented by a blue diamond icon) with a progress bar showing 4 out of 4 segments.
  - Might (represented by a red 'X' icon) with a progress bar showing 4 out of 4 segments.
- Description:** A moment ago, this province was depleted of all its loot. Mountain Kobolds are compiling building materials, and the wealth mining operations are deserted. There are no resources here.
- Time:** 32

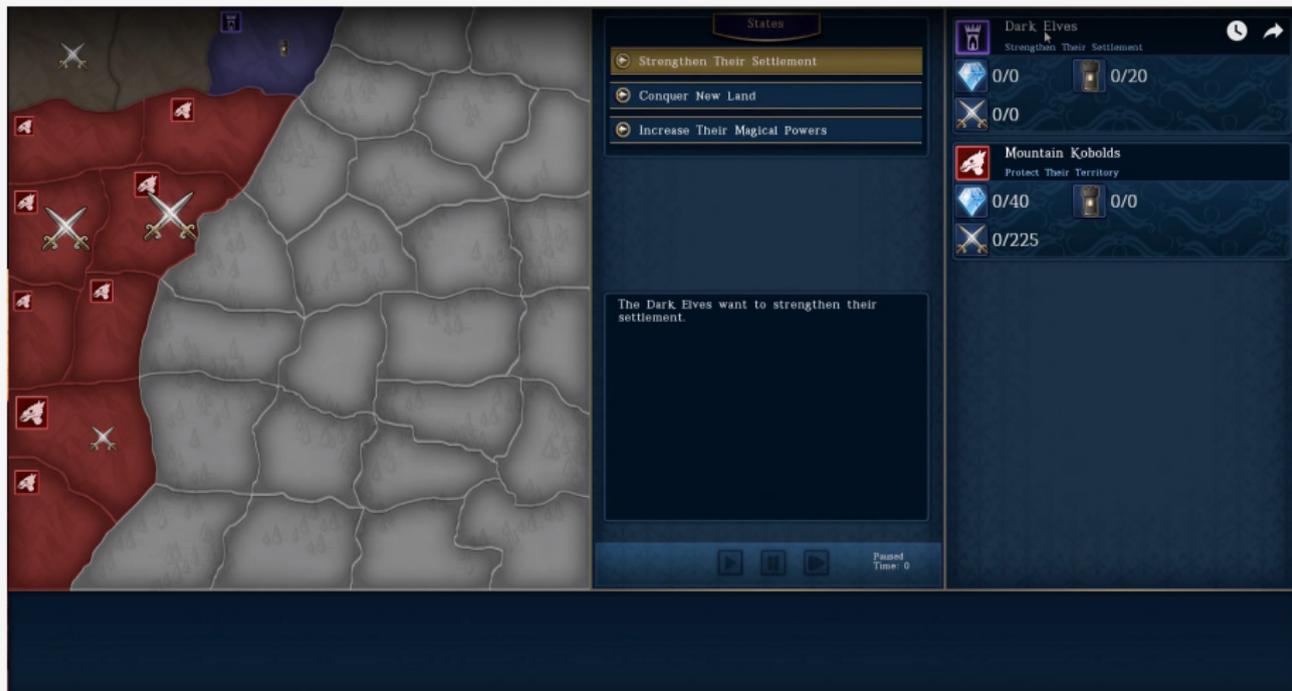
**Log of Events:**

- The Mountain Kobolds are establishing a new base camp. Their control over the land grows even greater.
- The Mountain Kobolds are mining cave gold, working steadily to increase their hoard. Their cache of materials grows deeper.
- The Mountain Kobolds are mining cave gold, working steadily to increase their hoard. Their cache of materials is expanding.
- The Mountain Kobolds are mining cave gold, working steadily to increase their hoard. Their hoard of wealth is expanding.
- The Mountain Kobolds are mining cave gold, working steadily to increase their hoard. Their hoard of wealth grows even greater.
- The Mountain Kobolds are smashing open crystal clutches, working steadily to increase their hoard. Their cache of materials is expanding.
- The Mountain Kobolds are smashing open crystal clutches, working steadily to increase their hoard. Their cache of materials grows even greater.

**Right Panel:**

- Mountain Kobolds:** Increase Their Hoard (represented by a red square with a white 'A').
- Wealth:** 150/0 (represented by a blue diamond icon).
- Might:** 0/225 (represented by a red 'X' icon).

## Demo



## Demo

The screenshot displays a game interface with three main sections:

- Map (Left):** Shows a portion of a game world with a red territory on the left and grey terrain on the right. Several icons (swords and a horse) are placed on the red territory.
- States Menu (Middle):** A dark blue panel titled "States" with three options:
  - Strengthen Their Settlement (highlighted)
  - Conquer New Land
  - Increase Their Magical Powers
 Below the menu is a text box: "The Dark Elves want to strengthen their settlement." At the bottom right of this panel, it says "Paused Time: 2".
- Resource Panel (Right):** A dark blue panel showing resource levels for two factions:
  - Dark Elves:** "Strengthen Their Settlement" with a diamond icon at 0/0 and a torch icon at 0/20. A sword icon shows 0/50.
  - Mountain Kobolds:** "Protect Their Territory" with a diamond icon at 0/40 and a torch icon at 0/0. A sword icon shows 0/225.

At the bottom left, a list of events is shown:

- 1 Some players have helped build a new outpost, increasing the Night Elves' hold on the land.
- 2 Players have helped fortify a new stronghold, increasing the Night Elves' hold on the land.

## Demo

The screenshot displays a game interface with three main sections:

- Map (Left):** A map showing a red territory on the left and a grey territory on the right. Several icons (swords, horses, and a castle) are placed on the red territory.
- States Menu (Middle):** A menu titled "States" with three options:
  - Strengthen Their Settlement
  - Conquer New Land (highlighted)
  - Increase Their Magical Powers
- Player Status Panel (Right):** A panel showing the status of two players:
  - Dark Elves:** "Conquer New Land" progress: 0/0 (diamond icon), 0/35 (castle icon), 0/35 (swords icon).
  - Mountain Kobolds:** "Protect Their Territory" progress: 0/40 (diamond icon), 0/0 (castle icon), 0/225 (swords icon).

Below the States menu, a text box reads: "The Dark Elves want to strengthen their settlement."

At the bottom left, a list of actions is shown:

- 1 Some players have helped build a new outpost, increasing the Night Elves' hold on the land.
- 2 Players have helped fortify a new stronghold, increasing the Night Elves' hold on the land.
- 3 The players have split mighty sandstone stones to assist the Night Elves, increasing their control.

At the bottom right, there are navigation icons and the text "Paused Time 3".

## Demo

The screenshot displays a game interface with three main sections:

- Map (Left):** A dark blue map showing a region with several icons (swords, a key, and a castle) and a red area in the bottom-left corner.
- Mission Menu (Middle):** A panel titled "Status" with three mission options:
  - Strengthen Their Settlement
  - Conquer New Land (highlighted)
  - Increase Their Magical Powers
 Below the menu, a text box reads: "The Dark Elves want to strengthen their settlement."
- Status Panel (Right):** A panel showing the status of two factions:
  - Dark Elves:** "Conquer New Land" with progress 0/35 (diamond icon) and 0/70 (key icon). A sword icon shows progress 10/220.
  - Mountain Kobolds:** "Protect Their Territory" with progress 0/5 (diamond icon) and 0/0 (key icon). A sword icon shows progress 0/0.

At the bottom of the screen, a log shows a series of events:

- 4 Some players have helped create new weapons for the Dark Elves in their struggle against the kobolds.
- 5 The players have slain elite kobold fighters, making safe a new territory for the Dark Elves.
- 6 The players have slain elite kobold fighters, making safe a new territory for the Dark Elves.
- 7 Some players have helped enhance bows for the Dark Elves in their struggle against the kobolds.
- 8 Players have pushed back the kobolds, securing a new territory for the Dark Elves.
- 9 The players have slain elite kobold fighters, securing a new region for the Dark Elves.
- 10 Players have helped create new swords for the Dark Elves in their battle against the kobolds.
- 11 The players have slain elite kobold fighters, making safe a new territory for the Dark Elves.

## Demo

The screenshot displays a game interface with three main panels:

- Map Panel (Left):** Shows a dark purple map with various icons and a central yellow crosshair.
- Mission Menu Panel (Middle):**
  - Header: States
  - Options:
    - Strengthen Their Settlement
    - Conquer New Land
    - Increase Their Magical Powers** (highlighted)
  - Traits: Spiritual
  - Build a Shadow Pit
  - Text: The Dark Elves want to strengthen their settlement.
  - Bottom: Paused Time 33
- Character/Status Panel (Right):**
  - Dark Elves:** Increase Their Magical Powers. Progress: 0/40 (diamond icon), 0/100 (candle icon).
  - Mountain Kobolds:** Protect Their Territory. Progress: 0/0 (diamond icon), 0/0 (candle icon).
- Log Panel (Bottom):**
  - 23 The Night Elves are constructing a shadow pit, assisted by players. The twisted essences from their dark temples are collecting in its depths.
  - 24 The Night Elves are crafting a shadow pit, assisted by some players. The corrupted essences from their dark temples are pooling in its depths.
  - 25 The Night Elves are crafting a shadow pit, assisted by players. The changed essences from their dark temples are collecting in its depths.
  - 26 With help from some players, the Night Elves are crafting a shadow pit, pooling the corrupted essences from their dark temples.
  - 27 The Night Elves are crafting a shadow pit, assisted by the players. The twisted essences from their dark temples are collecting in its depths.
  - 28 With help from players, the Night Elves are crafting a shadow pit, collecting the twisted essences from their dark temples.
  - 29 With help from players, the Night Elves are crafting a shadow pit, pooling the twisted essences from their dark temples.
  - 30 The Night Elves are completing a shadow pit, assisted by players. The corrupted essences from their dark temples are collecting in its depths.

# Demo



# Demo



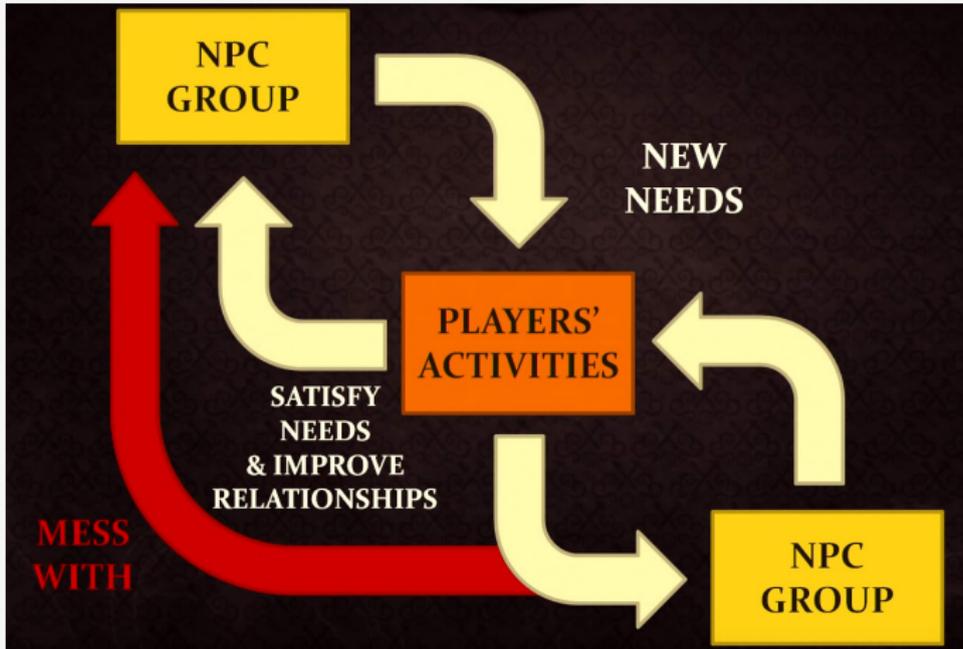
# Demo



# Demo



# NPC - Player Interaktion



src: Daybreak Game Company

# Quellen

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