Outbreak

Simulation der Ausbreitung von Krankheiten

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Praktikum “Parallele Programmierung”

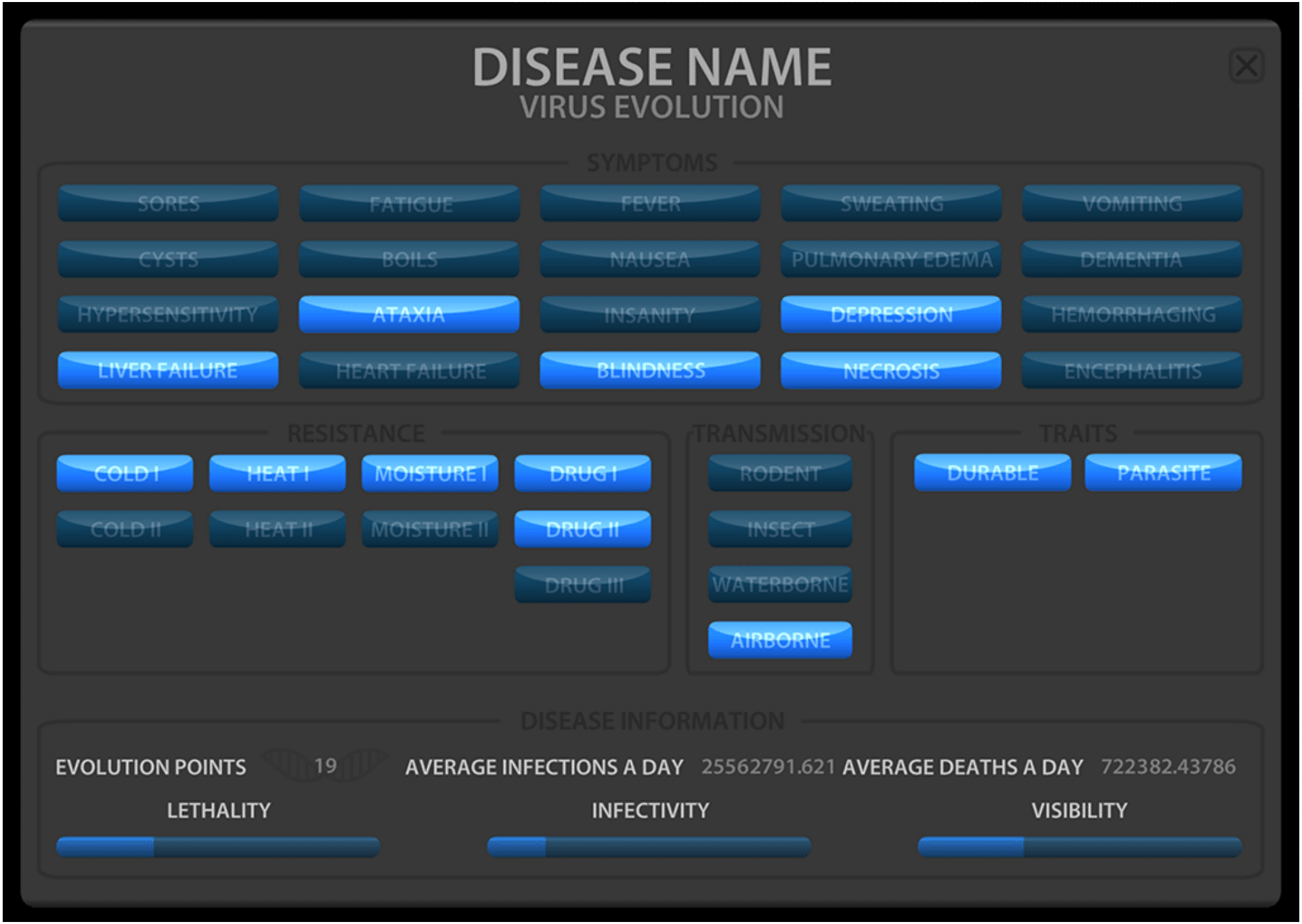
25.10.2012

Gliederung

- Einführung
  - Pandemic II
  - Simulation
- Aufgabenstellung
- Design
  - Welt
  - Länder
  - Menschen
  - Erreger


BREAKING NEWS
INDIA DEALING WITH WIDESPREAD FLOODING
SERIES OF HURRICANES HIT MIDDLE EAST
STORMS OVER MEXICO BEGINNING TO BREAK UP
SERIES OF HURRICANES HIT MEXICO
STORMS OVER MIDDLE EAST BEGINNING TO BREAK UP
MENU
WORLD
DISEASE
21
16 : 16 08 2008


WORLD INFORMATION
WORLD INFORMATION
ALIVE POPULATION 6327873011
DEAD POPULATION 0
HEALTHY POPULATION 6326380577
INFECTED POPULATION 1492434
DISEASE START DATE 03/08/2008
DAYS THAT HAVE PASSED 30
STARTING REGION SOUTH AFRICA
VACCINE STATUS
TOTAL NUMBER OF HOSPITALS 24
NUMBER OF ACTIVE HOSPITALS 24
APPROXIMATE DAYS TO COMPLETION n/a
COMPLETION
DEPLOYMENT
CLEAN REGIONS
UNITED STATES PERU
ARGENTINA BRAZIL
WEST EUROPE INDIA
EAST EUROPE MADAGASCAR
INDONESIA MIDDLE EAST
RUSSIA GREENLAND
CUBA
INFECTED REGIONS
CANADA MEXICO
AUSTRALIA NORTH AFRICA
SOUTH AFRICA JAPAN
NEW ZEALAND CHINA
FORSAKEN REGIONS


DISEASE NAME
VIRUS EVOLUTION
SYMPTOMS
SORES
FATIGUE
FEVER
SWEATING
VOMITING
CYSTS
BOILS
NAUSEA
PULMONARY EDEMA
DEMENTIA
HYPERSENSITIVITY
ATAXIA
INSANITY
DEPRESSION
HEMORRHAGING
LIVER FAILURE
HEART FAILURE
BLINDNESS
NECROSIS
ENCEPHALITIS
RESISTANCE
COLD I
HEAT I
MOISTURE I
DRUG I
COLD II
HEAT II
MOISTURE II
DRUG II
DRUG III
TRANSMISSION
RODENT
INSECT
WATERBORNE
AIRBORNE
TRAITS
DURABLE
PARASITE
DISEASE INFORMATION
EVOLUTION POINTS
19
AVERAGE INFECTIONS A DAY
25562791.621
AVERAGE DEATHS A DAY
722382.43786
LETHALITY
INFECTIVITY
VISIBILITY


BREAKING NEWS
GOVERNMENT OF EAST EUROPE DECLARES MARSHAL LAW TO PREVENT INFECTION
GOVERNMENT OF UNITED STATES BEGINS BURNING BODIES TO PREVENT INFECTION
GOVERNMENT OF UNITED STATES CLOSES SCHOOLS TO PROTECT CHILDREN AGAINST POSSIBLE INFECTION
GOVERNMENT OF UNITED STATES STARTING TO HAND OUT MASKS TO PREVENT INFECTION
GOVERNMENT OF WEST EUROPE STARTING TO HAND OUT MASKS TO PREVENT INFECTION
MENU
WORLD
DISEASE
24
04 : 07 10 2008


BREAKING NEWS
EAST EUROPE GETS HIT BY EARTHQUAKE AND AFTERSHOCKS
VACCINE HAS RESULTED IN NEW STRAIN OF DISEASE
AFTERSHOCKS HAVE CEASED IN EAST EUROPE
GREENLAND WIPED OUT BY NEW HAZARDOUS DISEASE
MEXICO SUFFERING FROM WIDESPREAD DROUGHT
GREENLAND
REGION INFORMATION
AFFLICTIONS
RIOTS ARE NOT IN EFFECT
FLOODS ARE NOT IN EFFECT
DROUGHTS ARE NOT IN EFFECT
HURRICANES ARE IN EFFECT
EARTHQUAKES ARE NOT IN EFFECT
SERVICES & INFRASTRUCTURE
AIRPORTS ARE OPEN
SHIPYARDS ARE OPEN
HOSPITALS ARE CLOSED
BORDERS ARE OPEN
TRANSIT IS CLOSED
SCHOOLS ARE CLOSED
GOVERNMENT AFFAIRS
NOT HANDING OUT WATER
NOT HANDING OUT MASKS
NOT EXTERMINATING RODENTS
NOT EXTERMINATING INSECTS
CURFEWS ARE NOT ENFORCED
MARTIAL LAW NOT IN EFFECT
DEAD BODIES NOT BEING BURNED
POPULATION
HEALTHY 0
INFECTED 0
DEAD 41852
ALIVE 0
MENU
WORLD
DISEASE
7
12 : 12 11 2008

Einführung

- Simulation von Krankheitsausbreitung
- Pandemic II ist witzig, aber zu ungenau und grob

- Weitere Faktoren einbeziehen
  - Mehrere Krankheiten?
  - Immunität?
  - Mutation des Erregers?

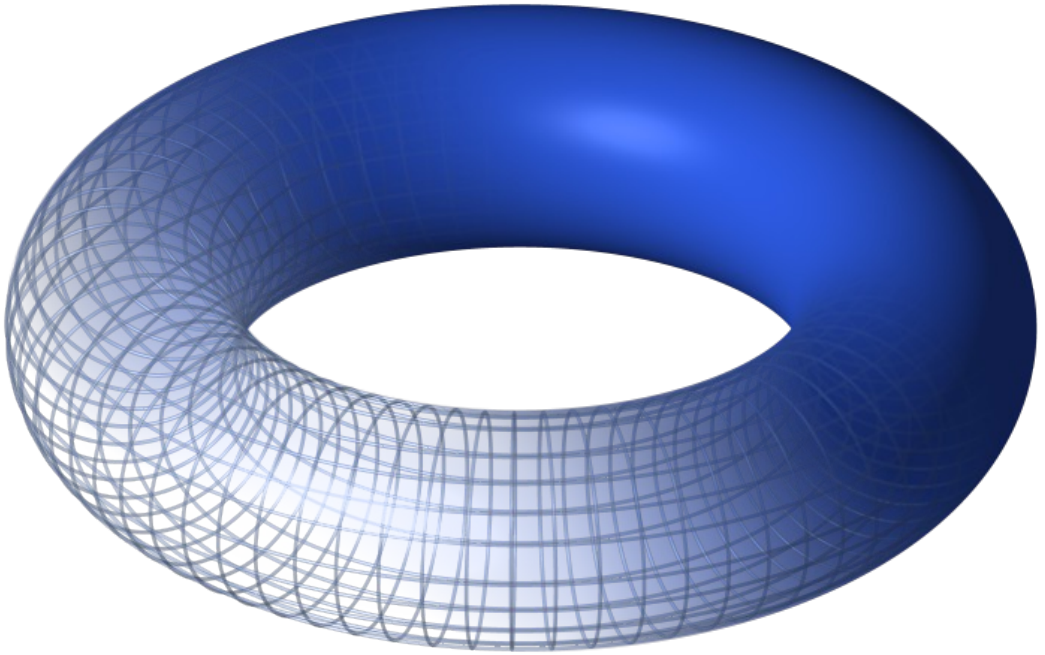
Aufgabenstellung

- Simulation einer Welt als Torus
  - Parallele Verarbeitung verschiedener Areale
  - Zusammengefasste Ausgabe als Frames

- Krankheitserreger
  - Mehrere Erreger gleichzeitig
    - Unterschiedliche Inkubations- und Latenzzeiten
    - Immunität möglich
    - Plötzliche Mutation möglich

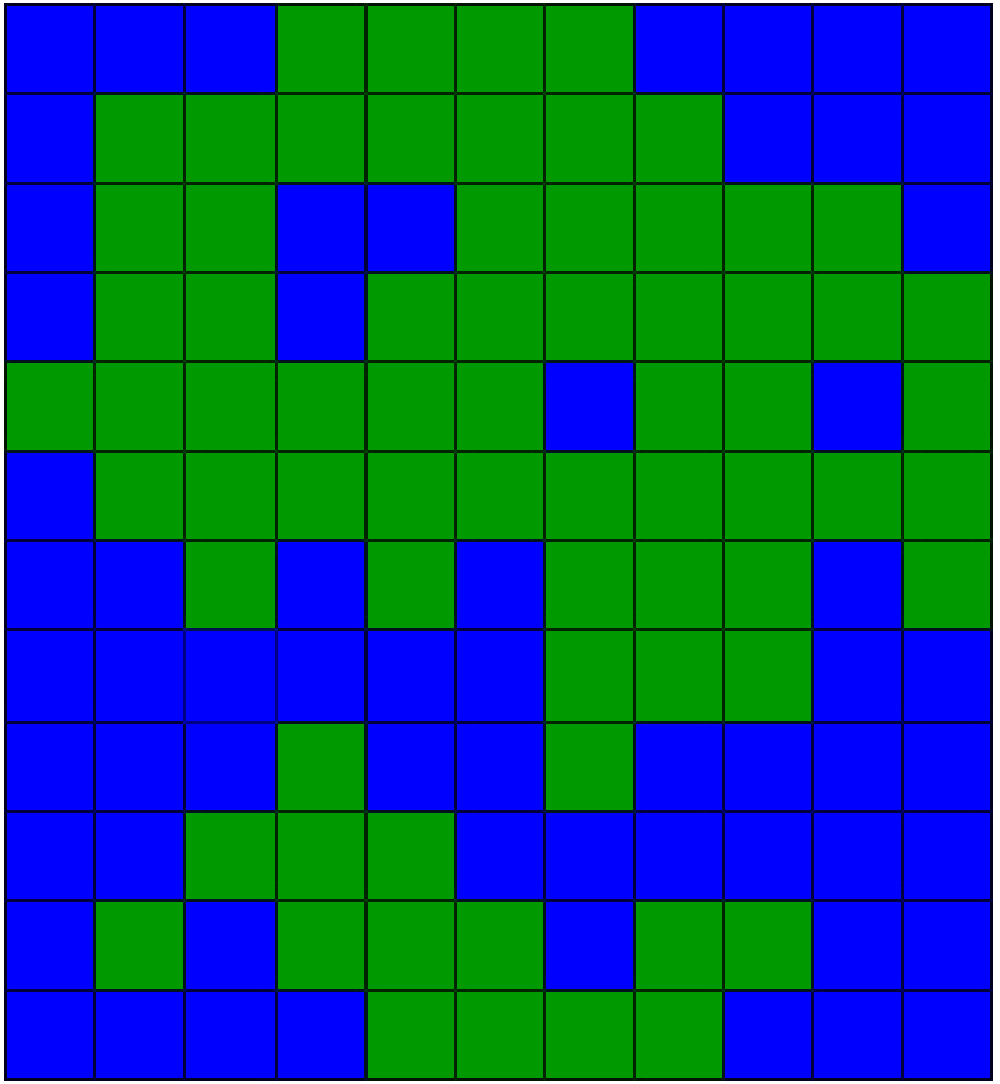
Design und Implementierung

- Welt
  - Torus
  - Matrix mit N x M Elementen

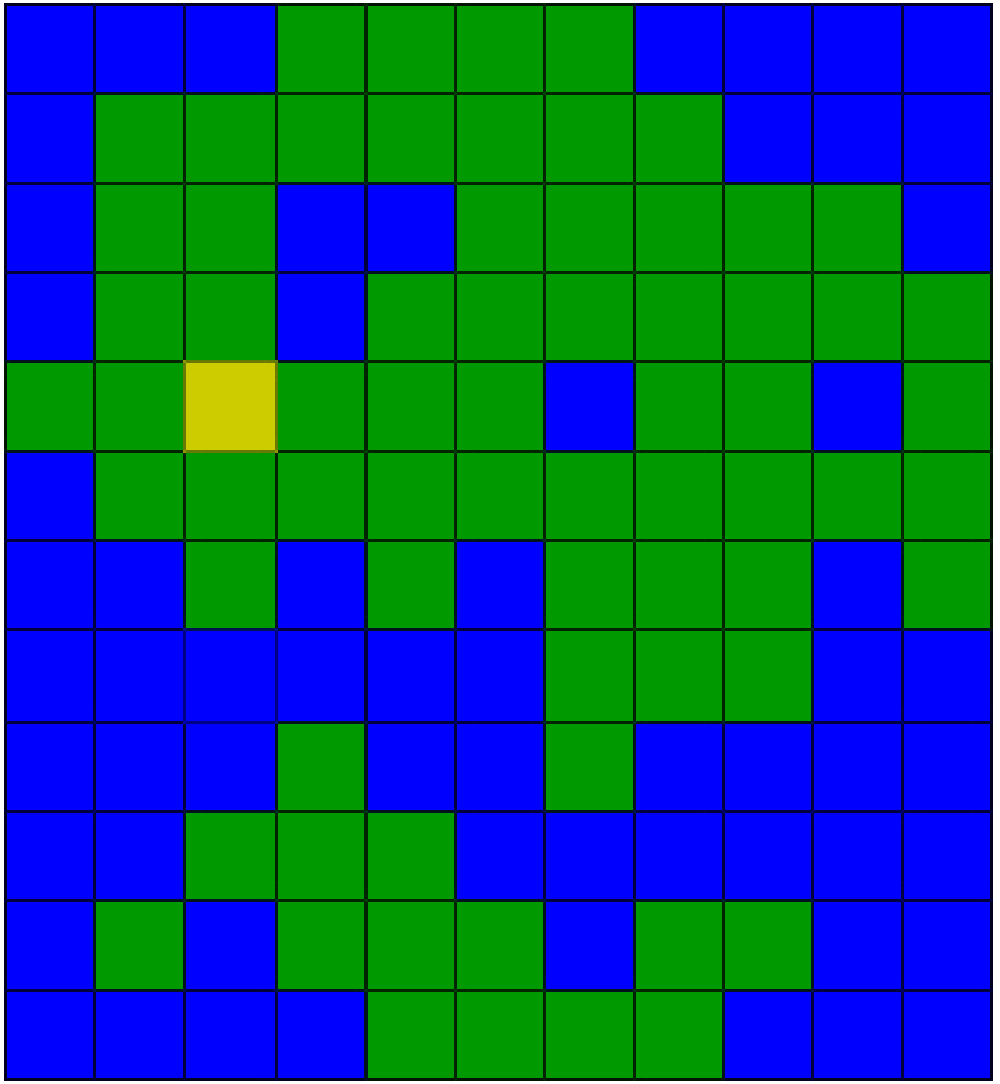


Quelle: http://upload.wikimedia.org/wikipedia/commons/1/17/Torus.png

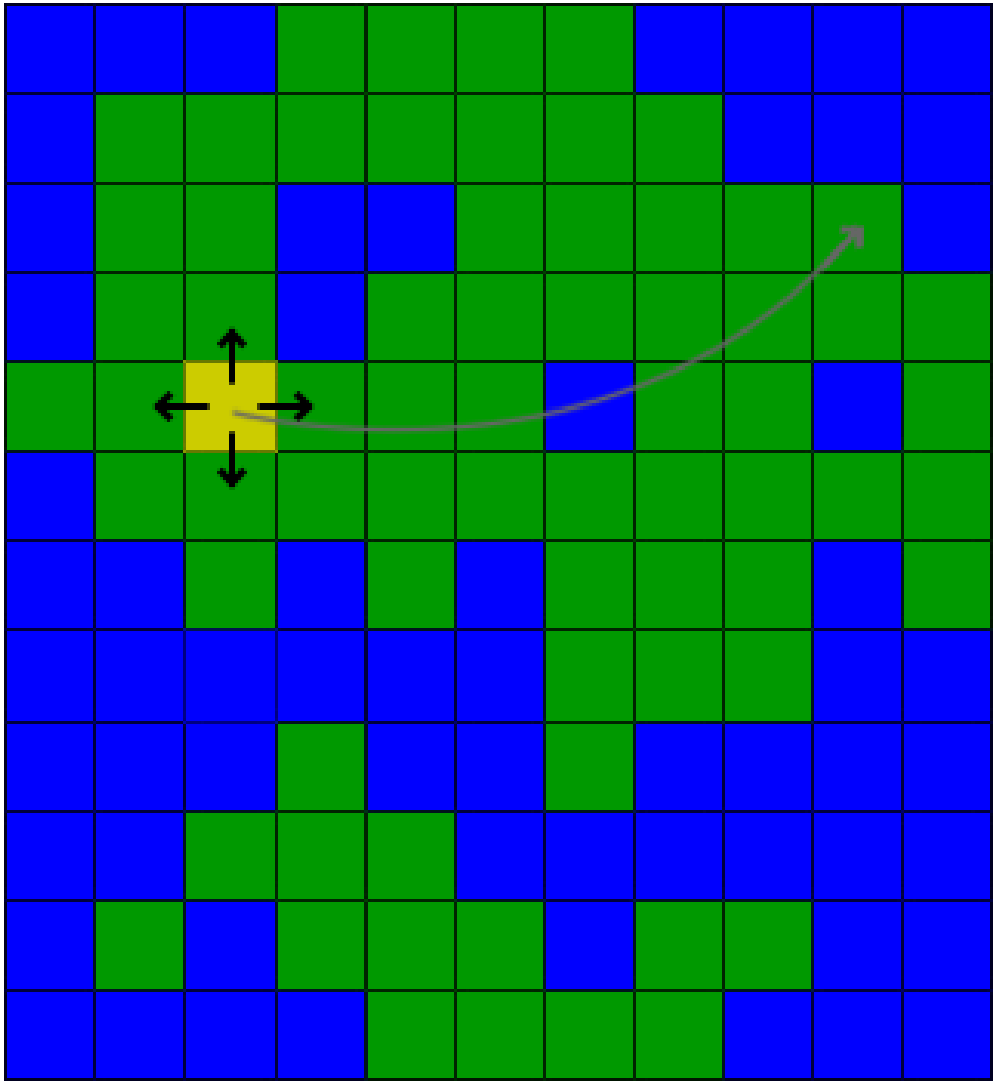
Design und Implementierung



Design und Implementierung



Design und Implementierung



Design und Implementierung

- Element = “Land”
  - Von Koordinaten abhängig
    - Temperatur
    - Bevölkerungsdichte
  - Randomisierte Koeffizienten
    - Maximales Alter
    - Reproduktion

Design und Implementierung

```
typedef struct s_country {
	float_t coeff_age;
	float_t coeff_reproduction;
	uint64_t population;
	person *people;
} country;
```

Design und Implementierung

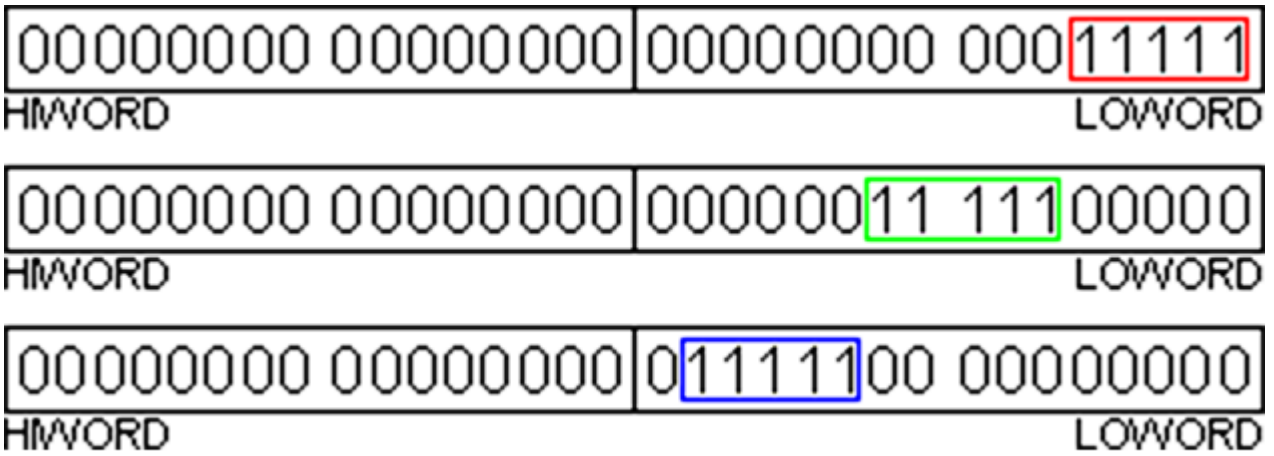
- Menschen
  - Alter
  - Gesundheit
    - Max abhängig von Alter und Land
  - Arrays mit
    - Getragenen Erregern
    - Immunitäten
    - Inkubationszeiten
    - Latenzen

Design und Implementierung

```
typedef struct s_person {
	uint8_t health;
	uint8_t age;
	uint8_t *incubation;
	uint8_t *latency;
	uint8_t *infected;
	uint8_t *immune;
} person;
```

Design und Implementierung

- Krankheitserreger
  - 64-Bit-Integer
    - Bis zu 64 als Bitmask kodierte Eigenschaften



Quelle: http://realmike.org/locking/masks.gif

Design und Implementierung

- Krankheitserreger
  - Mutationswahrscheinlichkeit
    - Randomisiert oder aus Datei eingelesen
    - Unterschiedlich von A → B, B → A, A → C, …
  - Latenz
  - Inkubationszeit
  - Umgebungsresistenz
  - Ansteckungsgefahr

Design und Implementierung

- Ablauf
  - Welt wird in Schritten berechnet bis
    - Immunität gegen alle Krankheiten existiert
    - Menschheit ausgestorben
    - Als Parameter übergebene Schrittzahl erreicht
- Fun fact
  - ~2.000.000 internationale Passagiere / Tag, täglich reisen knapp 0,03% der Menschheit