

Procedural Generation of Patient Scenarios for Medical Diagnosis Training

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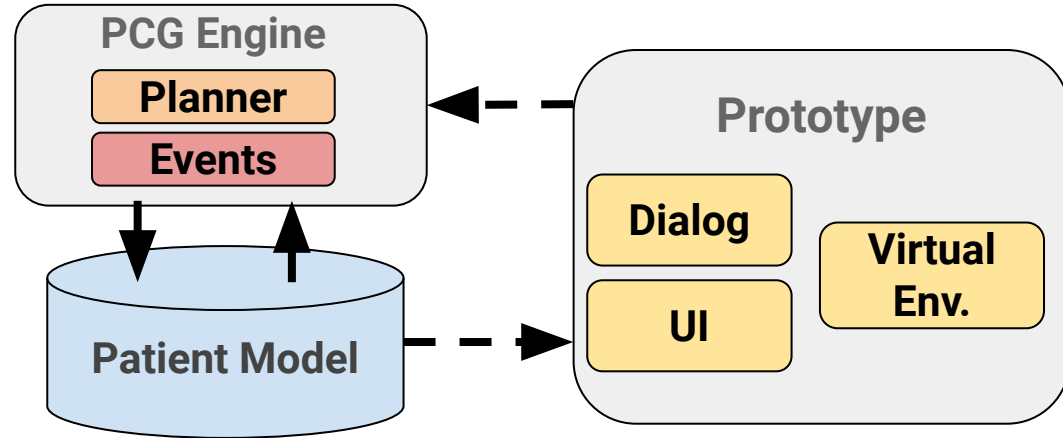
What are we doing? Why?

Today, the process of authoring patient scenarios for diagnostic training is largely **manual**. Manual authoring is **error prone** and **time-intensive**, which greatly limits scenario **quantity** and **variety**.

Approach

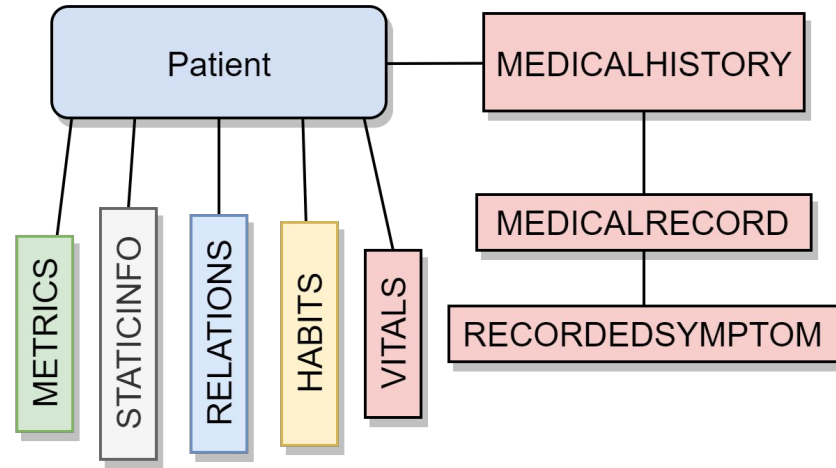
Our system is comprised of:

- Underlying patient data model
- A procedural algorithm - C#
- A prototype virtual environment - Unity



The Patient Model

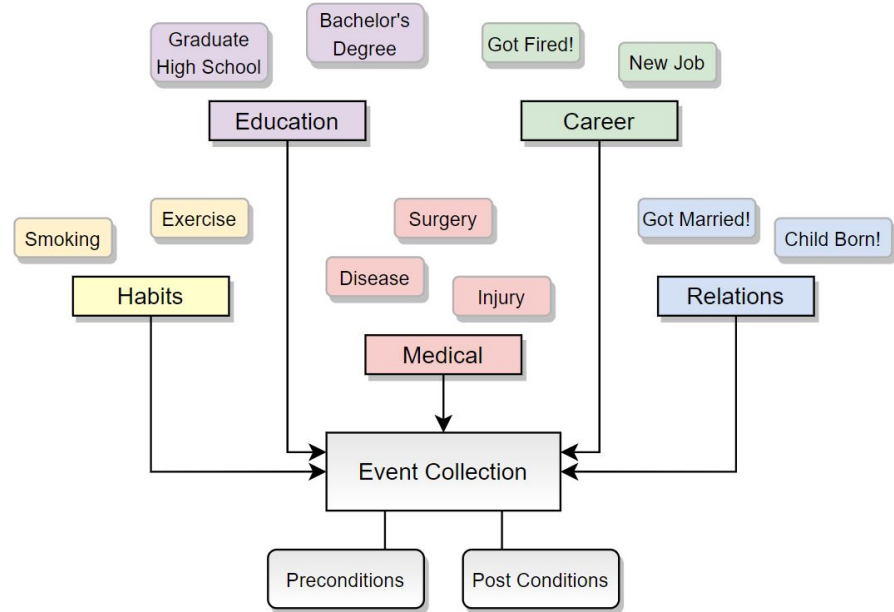
To generate a rich, realistic patient, the attributes or model of what represents a patient must first be established.



Procedural Generation

- Simulating the complexity of a human life.
- Life experiences are categorized into a collection of generic events.

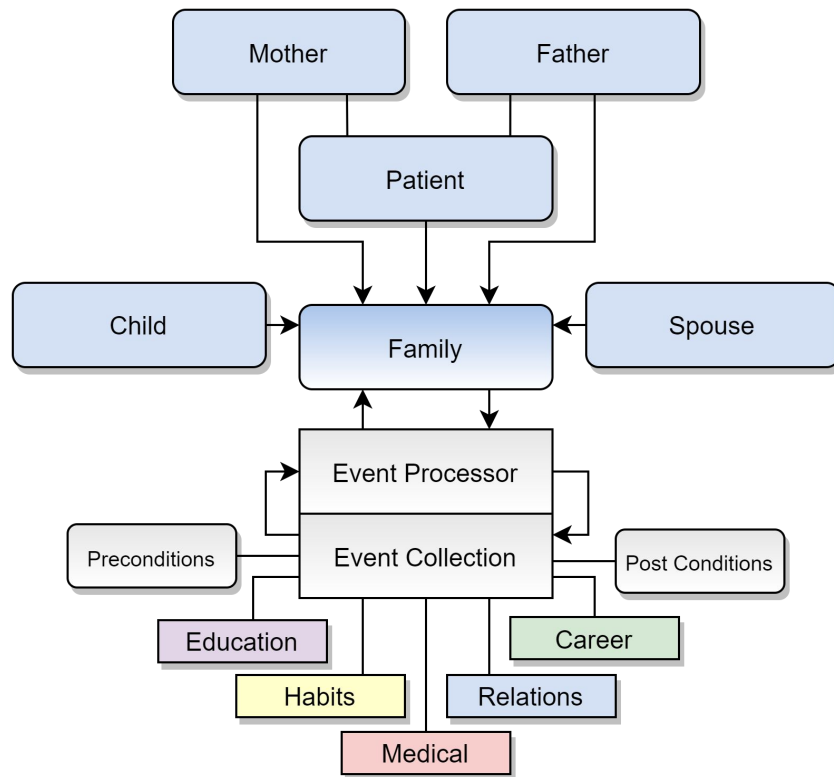
Building the Event Collection



Making virtual families

...and making them sick.

- Generated in realistic sequence.
- Patient inherits traits from parents.
- Patient can get married and have children.
- Once established, the family grows together.
- Events experienced by one family member can affect the others.

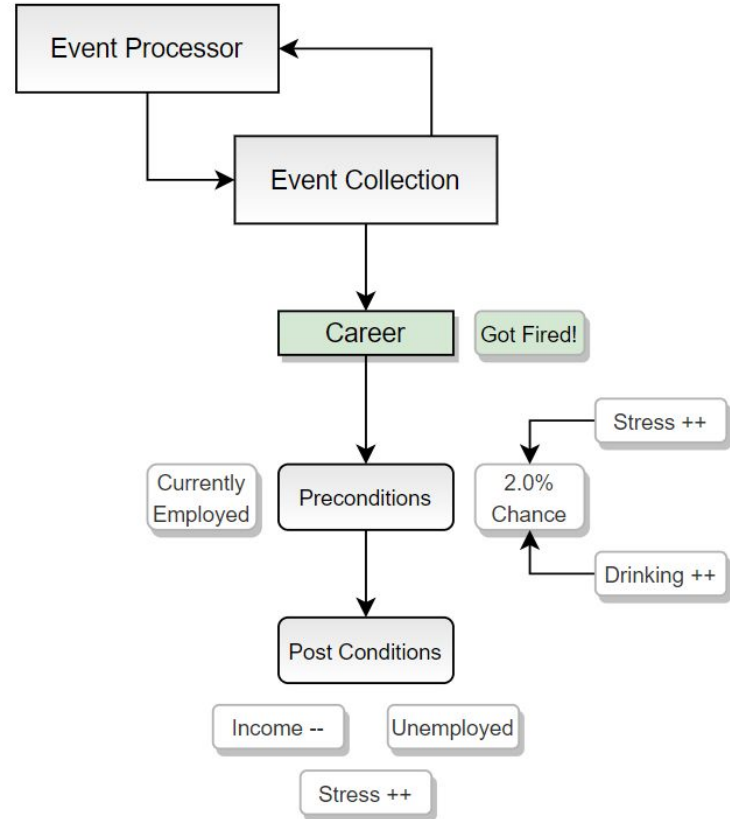


A “life” is a Series of Events

Every change has a cause

- Each event has:
 - Preconditions
 - Influenced by past events
 - Ensures event has proper context
 - Post Conditions
 - Makes changes to patient's state that influence future events

Applying Events



The Full Picture

- More than just medical history.
- Capturing the ambiguity of real life.

Mother Report	Father Report
Name: VICTORIA MCGUIRE	Name: HARRISON CHAPMAN
Sex: Female	Sex: Male
Relations	Relations
Mother: none	Mother: none
Father: none	Father: none
Spouse: HARRISON CHAPMAN (married 1 times)	Spouse: VICTORIA MCGUIRE (married 1 times)
Number of Children: 1	Number of Children: 1
+ Child 1 Name: ERIN CHAPMAN	+ Child 1 Name: ERIN CHAPMAN
Metrics	Metrics
Age: 65	Age: 68
Height: 5.79 feet	
Weight: 169.66 lbs.	
Accomplishment	
Education: HighSchool	
Career: Entrepreneur	
Financial	
Income Level: Wealthy	
HealthCare Access: VeryHigh	
Habits	
Diet: VeryPoor	
Exercise: Low	
Smoking: None	
Drinking: Medium	
Medical History	
Total Incidents: 20	
-- Chronic Bronchitis	
Chief Complaint: False	
Occured at age: 4	
Lasted for: ForLife	
Symptoms included:	
+ Coughing, High, VeryOff	
+ ExcessPhlegm, Moderate	
+ Wheezing, Moderate, O	
+ ChestPain, Moderate, O	
-- Flu	
Chief Complaint: False	
Occured at age: 8	
Lasted for: AWeek	
Symptoms included:	
+ Chills, Moderate, Often	
+ Coughing, Moderate, O	
+ Fatigue, VeryLight, Often	
+ Fever, VeryLight, VeryRa	
+ HeadAche, High, Often	

Patient Report
Name: ERIN CHAPMAN
Sex: Female
Relations
Mother: VICTORIA MCGUIRE
Father: HARRISON CHAPMAN
Spouse: ELEANOR FELIX (married 2 times)
Number of Children: 2
+ Child 1 Name: ANNA HUDSON
+ Child 2 Name: CARTER HUDSON
Metrics
Age: 36
Height: 5.84 feet
Weight: 154.36 lbs.
Accomplishment
Education: HighSchool
Career: Tech
Financial
Income Level: UpperMiddleClass
HealthCare Access: High
Habits
Diet: VeryPoor
Exercise: High
Smoking: High
Drinking: Medium
Chief Complaint
Chief Complaint: Chronic Bronchitis
Occured at age: 36
Lasted for: ForLife
Symptoms included:
+ Coughing, High, Often
+ ExcessPhlegm, Moderate, Often
+ Wheezing, Moderate, Often

The Prototype

This is the environment in which the doctor will interact with the patient.



User Interface

The user interface is the medium for displaying information to the user during diagnosis.



[Test For Vitals]

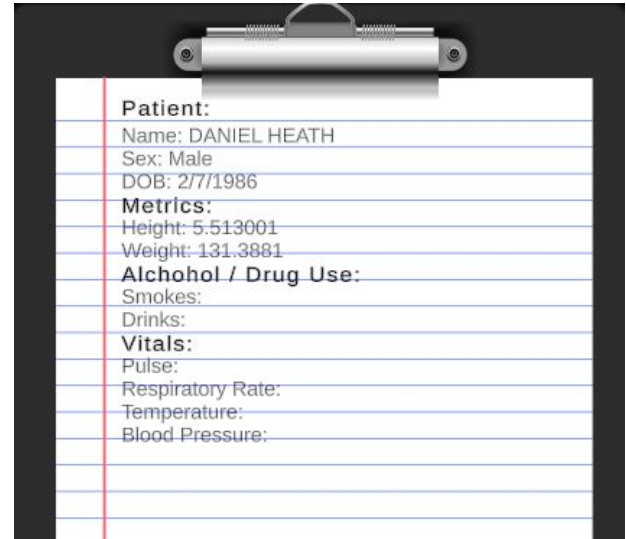
Do you drink at all?

Do you Smoke at all?

Do you exercise at all?

[Return To Menu]

How healthy is your diet?



Patient:
Name: DANIEL HEATH
Sex: Male
DOB: 2/7/1986

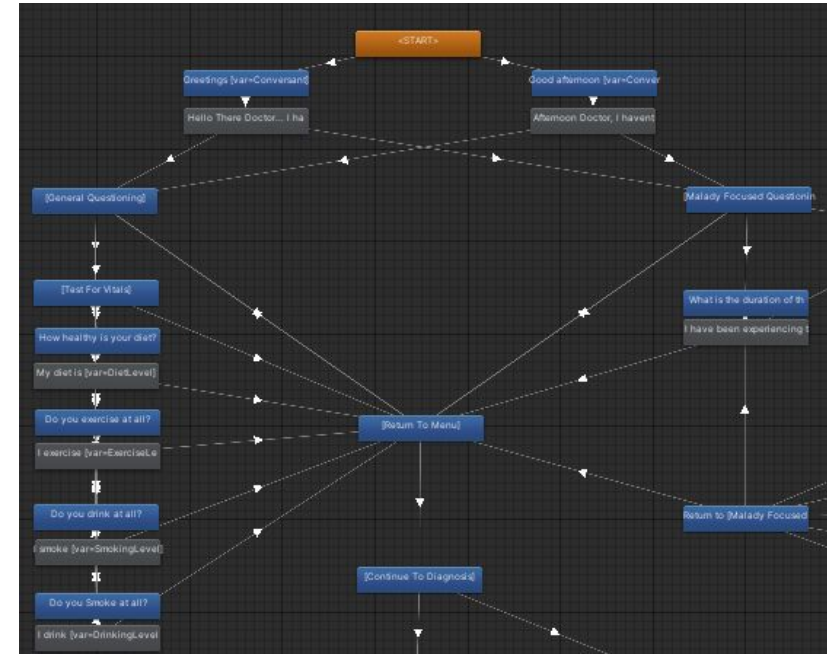
Metrics:
Height: 5.513001
Weight: 131.3881

Alcohol / Drug Use:
Smokes:
Drinks:

Vitals:
Pulse:
Respiratory Rate:
Temperature:
Blood Pressure:

The Dialogue System

This system provides a way for the user to interact with the patient, through the use of dialogue



Evaluation

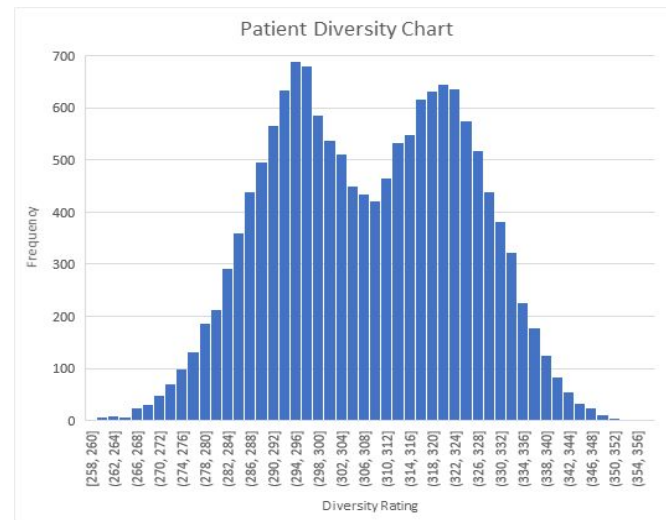
For evaluation, 15k patients were generated and analyzed for effectiveness.

Effectiveness was evaluated based on:

- Validity
- Diversity
- Efficiency $\rightarrow F(n) = \sim 1500n$, where n = Minutes

Evaluation of our system concludes that patient data is:

- Valid ☒ Diverse ☒ and can be Rapidly Generated ☒





Moving Forward & The Future!

- Tuning, Tuning, Tuning...
- Broaden the domain of maladies from only Respiratory to others such as Cardiovascular, Digestive, Nervous, ...
- Evaluation of patients by a medical professional
- IRB (Institutional Review Board)



Demo & Questions