

Forgotten Knowledge Tracker (FKT) - Complete Guide

What Is This?

Imagine you have a **super-smart friend** who:

- **Watches** what you're learning on your computer
- **Remembers** everything you studied
- **Predicts** when you'll start forgetting things
- **Reminds** you at the perfect time to review

That's exactly what FKT does! It's like having a personal AI tutor that runs quietly in the background while you study.

The Big Problem It Solves

"I studied this last week, but I already forgot it!"

Sound familiar? This happens because our brains naturally forget things over time. FKT prevents this by:

1. Automatically tracking what you learn
 2. Building a map of your knowledge
 3. Calculating when you'll forget
 4. Reminding you before it's too late
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How The System Works (The Big Picture)

Think of FKT as a **team of helpers**, each doing a specific job:

SENSORS (Watching You)

-  BRAIN (Understanding)
-  MEMORY (Tracking Forgetting)
-  SCHEDULER (Planning Reviews)
-  DASHBOARD (Showing You)

Part 1: The Watchers (Input Collection)

What They Do

These are like **digital eyes and ears** that observe your study session.

The 4 Watchers:

Screen Watcher (OCR)

- **What it does:** Takes screenshots of your screen every 20 seconds
- **How it works:** Uses a technology called **OCR (Optical Character Recognition)** - like how your phone can read text from photos
- **What it finds:** "Oh, they're reading about 'Neural Networks' and 'Machine Learning'"
- **Technology used:** Tesseract OCR + KeyBERT (keyword extraction)

Sound Watcher (Audio Classifier)

- **What it does:** Listens to your surroundings every 15 seconds
- **How it works:** Records 3 seconds of audio and uses **Machine Learning** to classify it
- **What it finds:** "Are they listening to a lecture (speech), music, or is it quiet?"
- **Technology used:** Librosa (audio processing) + MFCC features (audio fingerprints)

Eye Watcher (Webcam)

- **What it does:** Checks if you're looking at the screen every 45 seconds
- **How it works:** Uses **Face Detection** to find your face and eyes
- **What it measures:**
 - Are you looking at the screen?
 - How focused are your eyes? (using EAR - Eye Aspect Ratio)
 - Gives you an "attention score" from 0-100
- **Technology used:** dlib (face detection) + OpenCV (computer vision)

Activity Watcher (Keyboard & Mouse)

- **What it does:** Counts how much you type and move your mouse every 5 seconds
- **How it works:** Tracks every click and keystroke

- **What it measures:** "Interaction rate" - how active you are
- **Technology used:** pyinput (input monitoring)

What Happens Next?

All this information gets bundled into one **feature vector** - think of it as a snapshot:

[Screen: "neural networks", Sound: "speech", Eyes: 85% focused, Activity: 12 actions/sec]

Part 2: The Decision Maker (Intent Classifier)

What It Does

Takes all the information from the watchers and answers: "**What is the person REALLY doing?**"

The 3 Possible Answers:

1. **"Studying"** - Actively learning something
2. **"Passive"** - Just browsing or watching casually
3. **"Idle"** - Not really learning anything

How It Decides

Uses **Machine Learning** (trained on past examples) to look for patterns:

Example Decision Logic:

- Speech audio + High attention + Lots of typing + Study-related text = **"Studying"** 
- Music playing + Low mouse movement + No text = **"Idle"** 
- Video playing + Medium attention + No typing = **"Passive"** 

Technologies Used:

- **Random Forest or Support Vector Machine (SVM)** - These are ML algorithms that learn patterns
- Trained on labeled data (past sessions marked as studying/idle/passive)

Output:

Gives you an **Engagement Score** (0 to 1, where 1 = fully engaged)

Part 3: The Brain Map (Knowledge Graph)

What It Is

Imagine your brain as a **network of connected bubbles** - each bubble is a topic you learned, and lines connect related topics.

How It Works:

Step 1: Finding Concepts

When the screen watcher finds text like "Machine Learning" or "Neural Networks":

- Extracts the important keywords
- Uses **NLP (Natural Language Processing)** to understand meaning
- Creates **embeddings** - these are like "digital fingerprints" of meaning (384 numbers that represent the concept)

Step 2: Creating Nodes

Each new concept becomes a **node** (bubble) in the graph with:

- **Name:** "Neural Networks"
- **Embedding:** [0.1, 0.5, -0.3, ...] (the digital meaning)
- **Memory Score:** How well you remember it (0-1)
- **Count:** How many times you've seen it
- **Last Seen:** When you last studied it
- **Next Review:** When you should review it

Step 3: Connecting Ideas

The system uses **Cosine Similarity** to measure how similar two concepts are:

- If "Neural Networks" and "Deep Learning" are very similar → draw a line between them
- The **thickness of the line** shows how strongly they're connected

Example Graph:



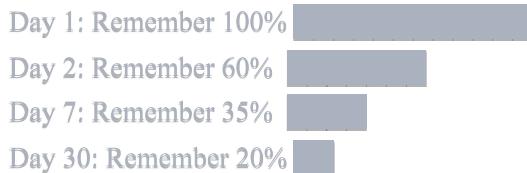
Technologies Used:

- **BERT/Sentence-BERT:** Advanced AI for understanding text meaning
 - **Graph Database:** Stores all nodes and connections
 - **Cosine Similarity:** Math formula to measure similarity (like finding the angle between two arrows)
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Part 4: The Forgetting Brain (Memory Model)

The Science Behind It

In 1885, a scientist named **Ebbinghaus** discovered that we forget things in a predictable pattern - fast at first, then slower:



How FKT Uses This

The Forgetting Formula:

$$\text{Memory Score} = e^{(-\text{decay_rate} \times \text{time_since_study})}$$

Where:

- e = special math number (2.718...)
- decay_rate = how fast you forget (0.1 by default)
- time = hours/days since you last studied

Real Example:

You studied "Python Basics" 3 days ago:

$$\text{Memory} = e^{(-0.1 \times 72 \text{ hours})} = e^{(-7.2)} = 0.07 = 7\%$$

Translation: You only remember 7% now - time to review!

Smart Adjustments

The memory score gets **boosted** if you:

- **Paid more attention** (higher webcam score) → remember better
- **Were actively studying** (intent = "studying") → remember better
- **Encountered it multiple times** → remember better

The Adjustment Formula:

$$\text{Final Memory} = \text{Base Forgetting} \times \text{Attention Factor} \times \text{Intent Factor} \times \text{Audio Factor}$$

Technologies Used:

- **Exponential Decay Model:** The Ebbinghaus formula
- **Multi-modal Weighting:** Combines attention, intent, and audio data
- **Time-series Tracking:** Continuously updates memory scores

Part 5: The Smart Planner (Spaced Repetition Scheduler)

What It Does

Plans your review schedule automatically - like a smart calendar that knows when you'll forget.

How It Decides When to Remind You

The Rules:

1. **If memory < 60%:** Review SOON (within 1 hour)
2. **If memory > 60%:** Wait longer based on how strong your memory is

The Scheduling Formula:

$$\text{Next Review Time} = \text{Current Time} + (\text{Base Interval} \times \text{Memory_Score}^2)$$

Example:

- Memory Score: 0.8 (80%)
- Base Interval: 10 hours
- Next Review: Now + $(10 \times 0.8^2) = \text{Now} + 6.4 \text{ hours}$

Why Square the Memory Score?

- Strong memory (0.9) → 0.81 → Wait even longer
- Weak memory (0.5) → 0.25 → Review much sooner

Personalization

Everyone forgets at different speeds, so the system learns YOUR patterns:

- If you always remember well → Increases intervals
- If you often forget → Decreases intervals

Technologies Used:

- **Adaptive Spacing Algorithm:** Adjusts based on your performance
 - **Priority Queue:** Sorts reviews by urgency
 - **Notification System:** Sends reminders to your computer
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Part 6: The Display (Dashboard)

What You See

This is your **control center** - a beautiful visual interface showing everything.

The 5 Main Views:

1. Knowledge Graph Visualization

- See all your learned concepts as connected bubbles
- **Green bubbles** = Strong memory
- **Orange bubbles** = Fading memory
- **Red bubbles** = Almost forgotten - review now!
- Click any bubble to see details

2. Memory Decay Curves

- Shows the forgetting curve for each concept
- Predicts when you'll forget
- Displays past reviews and their impact

3. Session Timeline

- When did you study?
- How long did you study?
- What did you learn?
- Heatmap showing your study patterns

4. Engagement Metrics

- Attention score over time
- Intent classification results
- Focus percentage
- Study quality indicators

5. Upcoming Reviews

- List of concepts needing review
- Priority (urgent vs. can wait)
- One-click review button

Technologies Used:

- **Streamlit:** Creates the web-based dashboard
 - **Plotly/Matplotlib:** Makes interactive charts
 - **Network Visualization:** Shows the knowledge graph
 - **Real-time Updates:** Refreshes as you study
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Part 7: The Learning Loop (Continuous Improvement)

How The System Gets Smarter About YOU

Every time you study or review something, FKT learns:

The Feedback Cycle:

1. You study "Python" → System tracks it
2. System predicts you'll forget in 3 days
3. After 3 days, system asks: "Do you remember Python basics?"
4. You answer (or it detects from your usage)
5. System adjusts:
 - Remembered easily? → Next review in 7 days
 - Struggled? → Next review in 1 day
6. Your personal "forgetting pattern" is updated

What Gets Personalized:

- **Decay Rate:** How fast YOU forget (not average person)
 - **Best Study Times:** When you're most focused
 - **Optimal Review Intervals:** Unique to your memory
 - **Concept Difficulty:** What's hard/easy for you
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Technical Details (For The Curious)

System Requirements

- **Memory:** 500MB - 1GB RAM
- **CPU:** 5-15% usage (spikes during processing)
- **Storage:** 100MB + your learning data
- **OS:** Windows, Mac, or Linux

Processing Schedule

Task	How Often	Processing Time
Main Loop	Every 5 seconds	1-2 seconds
Screen Capture	Every 20 seconds	2-4 seconds
Audio Analysis	Every 15 seconds	3 seconds
Webcam Check	Every 45 seconds	2-3 seconds
Graph Save	Every 5 minutes	1 second
Review Check	Every 1 minute	< 0.5 seconds

Data Storage

Everything is saved in:

- **SQLite Database:** All your sessions and logs
- **Knowledge Graph File:** Your concept network
- **Model Files:** The trained AI models

Privacy & Security

- **Everything runs locally** on your computer
 - **No data sent to internet** unless you choose
 - **You own all your data**
 - **Can delete everything anytime**
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Real-World Example: A Day With FKT

Morning (10:00 AM):

You: Opens textbook on "Machine Learning"

FKT:

- Screen: Detects "Machine Learning", "Supervised Learning"
- Audio: Silence (focused reading)
- Webcam: 85% attention
- Activity: Moderate typing (taking notes)
- Decision: "Studying"
- Action: Adds concepts to knowledge graph

Afternoon (2:00 PM):

You: Watching YouTube video about Python

FKT:

- Screen: Detects "Python tutorial"
- Audio: Speech (tutorial audio)
- Webcam: 70% attention
- Activity: Low (just watching)
- Decision: "Passive Learning" 
- Action: Logs with lower engagement weight

Next Day (11:00 AM):

FKT Checks Memory:

- "Machine Learning" studied yesterday
 - Memory Score: 72% (still good)
 - No reminder yet
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- "Python Basics" studied 5 days ago
 - Memory Score: 58% (danger zone!)
 - Action: Sends notification 
- "Hey! Time to review 'Python Basics' before you forget!"

Why This Works (The Science)

1. Multi-Modal Learning Detection

Using multiple sensors is more accurate than just one:

- Screen alone: Might be open but you're not reading
- Audio alone: Can't tell what you're listening to
- Webcam alone: You might be staring blankly
- **All together:** Highly accurate picture of learning

2. Spaced Repetition Science

Proven by 100+ years of research:

- Reviewing right before forgetting = Maximum retention
- Spacing reviews = Less total study time needed
- **Result:** 40-60% better retention with less effort

3. Semantic Knowledge Organization

Your brain doesn't store random facts - it builds networks:

- FKT mirrors this with the knowledge graph
- Connected concepts reinforce each other
- Easier to remember related ideas together

Getting Started

Simple Setup:

1. **Install** the program
2. **Grant permissions** (screen, webcam, microphone)
3. **Start tracking** - it runs in the background
4. **Check dashboard** whenever you want insights
5. **Review when notified** - stay on top of your knowledge!

First Week Experience:

- **Days 1-2:** System learns your patterns
 - **Days 3-5:** Knowledge graph starts forming
 - **Week 2+:** Personalized review schedule kicks in
 - **Month 1+:** Noticeable improvement in retention
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The Magic Moment

Imagine this:

You're coding a new project and think "Wait, what was that algorithm I learned last month?"

Before you can search Google, FKT sends a notification:

"Perfect timing! Let's review 'Sorting Algorithms' - you were scheduled to review this today anyway!"

You review for 5 minutes, and it sticks in your memory for weeks longer.

That's the power of FKT - turning forgetfulness into lasting knowledge! 

Summary: The Full Journey

YOUR STUDY SESSION



SENSORS WATCH

(Screen + Audio + Webcam + Activity)



AI UNDERSTANDS

(Intent Classifier: "Are they studying?")



KNOWLEDGE GRAPH GROWS

(New concepts added, connections made)



MEMORY TRACKED

(Forgetting curve calculated)



REVIEWS SCHEDULED

(Smart reminders planned)



YOU GET NOTIFIED

(Review at perfect time)



KNOWLEDGE RETAINED

(You never forget what matters!)

The Bottom Line: FKT is like having a photographic memory assistant that never sleeps, always remembers what you learned, and knows exactly when to remind you - all working silently in the background while you focus on learning! 