



# From Physical Game to Computer Game

By Scott Kim

This article originally appeared in The Games Cafe, a now defunct web site devoted to lovers of board games and puzzles.

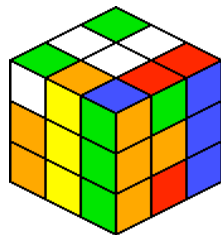
As a computer game designer, I'm always looking for new ideas. And one of the best places to look for computer game ideas is to earlier non-computer games, such as board games, mechanical puzzles and paper and pencil games. There's also a wealth of material in books about recreational mathematics aching to be exploited.

But there's more to translating an idea into the computer medium than merely copying it. Here are some of the lessons I've learned about what works. Most of the examples come from puzzle games – my specialty – but many of the lessons apply to other sorts of games as well.

---

## Literal Translations Don't Always Work

Rubik's Cube is one of the most popular mechanical puzzles of all time. But even a good computer version of Rubik's Cube, like Michael Schubert's [Rubik's Cube Java Applet](#), is nowhere nearly as fun to play. Why?



*Rubik's Cube doesn't translate well into software*

The reason that Rubik's Cube doesn't translate well into the computer medium is that it is fundamentally a 3-dimensional tactile experience. The cube has a charming physical presence that invites you to pick it up and play with it. The basic move of twisting a face fits the hand naturally. It is easy to turn the cube around in your hand and see all the faces.

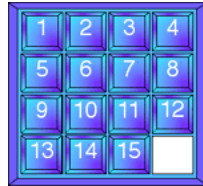
Computers, however, deal with 3-dimensional objects poorly. Twisting the faces of a cube by clicking buttons is more difficult and less satisfying than doing it by hand. It is awkward at best to rotate a 3-dimensional cube with a 2-dimensional mouse. All the tactile pleasure of Rubik's Cube is lost. So when you turn a physical game into a computer game, beware of what you might be giving up.

---

## So Learn to Take Poetic License

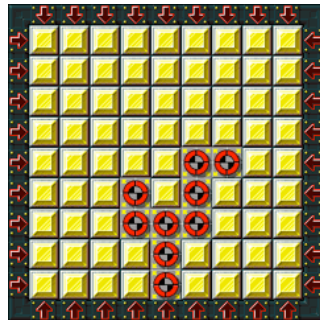
Instead of translating Rubik's Cube literally, a better approach is to abstract out the core of the game, ignoring its three-dimensionality, then find something equivalent in the computer medium. Ask yourself "What larger category of games includes this game?"

At its core, Rubik's cube is a permutation puzzle. You are given a fixed number of elements, and operations for rearranging those elements, several at a time. Your goal is to rearrange the elements until they make a particular configuration.



*Rubik's Cube is a permutation puzzle, similar to a sliding block puzzle*

Another common example of a permutation puzzle is sliding block puzzles. The difference is that in Rubik's cube you must always move a block of several elements at the same time, whereas in a typical 4 by 4 sliding block puzzle you can focus on moving one element at a time.



*Cogito is a poetic translation of Rubik's Cube onto the computer*

My vote for the best translation of Rubik's Cube into the computer medium is the computer puzzle game Cogito, published many years ago by Inline. Like Rubik's Cube, Cogito is a permutation puzzle in which you can only move a group of elements at a time. Instead of a 3 by 3 by 3 cube, however, you are given a 6 by 6 array of square tiles. And instead of twisting a face of a cube, the basic move is shifting a horizontal or vertical line of tiles forward or backward one square. The tile that goes off the edge of the board wraps around to the opposite edge.

The beauty of Cogito is that the moves work well in the computer medium: just click an arrow to shift a line of tiles one square. Because it is two-dimensional all the elements are always visible – no need to turn the board. In addition, Cogito features a series of levels that start easy and get harder, making it easy for beginners to learn how to play the game. In theory the same sequencing would work for Rubik's Cube, but because it is a physical game it would be too expensive to sell a box of 50 progressively more difficult cubes.

Jeopardy! Online on the [Sony Station](#), which I had a small part in designing, is another example of how a game can change in translation. Our goal was to reproduce the TV game show experience faithfully, allowing people on the web to participate as players.



*Unlike the TV show, Jeopardy! Online uses multiple choice questions*

One aspect, however, proved difficult to translate. On the TV show players speak their responses, and human judges decide whether the response was correct. Providing a human judge online would have been too expensive, so Sony decided to take poetic license and make the responses multiple choice. This changes the strategy of the game a bit, but it is much easier to automate and while still feeling like Jeopardy!

---

## Know the Limitations of the Medium

Every medium has its strengths and limitations. Print is great for reproducing static images in fine detail, but it can't reproduce motion. Video is great for reproducing motion, but it isn't interactive. Computers are interactive, but they can't reproduce images in fine detail.

Whenever you design a game, you should be aware of the limitations and strengths of the medium. You want to design within the limitations, while taking advantage of the strengths. Here are six factors to consider in designing for the computer medium.

**Graphics.** How big is the display area? How many colors can you display? Does the machine include 3d acceleration hardware? These are the first questions I ask when I design a computer game. When you design a game for a generic PC you must decide on the minimum required system configuration. Game consoles like the Sony Playstation and Nintendo 64 simplify this decision by providing a single standard system configuration.

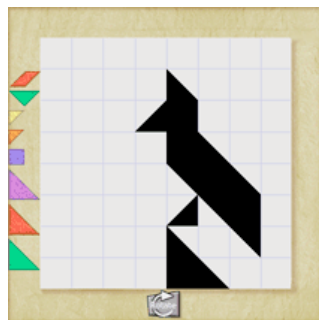
**Sound.** Sound is great, but many people never bother to hook up their speakers, or play games in environments where sound would be disruptive. You must decide whether the sound in your game will be an essential or optional part of the experience. For instance, Myst includes several puzzles that rely primarily on sound..

**Response time.** Players hate to wait. How fast can the system

respond to input? For online games, the response time includes lag introduced by the internet. For standalone games, the response time depends on processor speed as well as how much the processor is being asked to do. For instance, Hasbro Interactive's computer versions of board games like Scrabble and Boggle sometimes react slowly because they try to display a photorealistic rendition of the board. If the designers had settled for more stylized graphics, response time would have been snappier.

**Input devices.** You don't want using the controls to get in the way of playing the game. Ideally the controls should be so simple that players never have to take their eyes off the screen to look at their hands. For instance, the popular puzzle game Tetris is played with just four buttons, which fit easily under the fingers of one hand.

Sometimes it is better to simplify a game so it is easier to control. For instance, I recently designed a version of the classic assembly puzzle Tangrams for Scott Kim's Puzzle Box on the kid's online service [JuniorNet](#). To be faithful to the original game I should have allowed pieces to be placed anywhere on the board and at arbitrary angles. But on a computer such precise positioning is tedious for the player, and makes it hard for the computer to verify whether a solution is correct. Instead, I restricted piece positions to a square grid, with only 90 degree rotations allowed. The resulting game is less rich than traditional tangrams, but still fun, and much easier to control than a literal translation of tangrams.



*Tangrams on Juniornet restricts pieces to a square grid, to keep moves simple.*

**Storage.** Does your machine have some form of permanent storage, like a hard disk or flash card? Until recently, console game machines have never had built-in permanent storage. As a result games have passwords that let a player jump to the point in the game where they left off. In effect the passwords act as memory.

**Net connection.** More and more games include an option to play with other people online. Even solitaire games can take advantage of the net: the single-player games on Gamescene ([www.gamescene.com](http://www.gamescene.com)) all include a high-score board where players can record their best scores, and see how well other players have done that day. High score boards are one of the most powerful way to motivate players to keep playing.

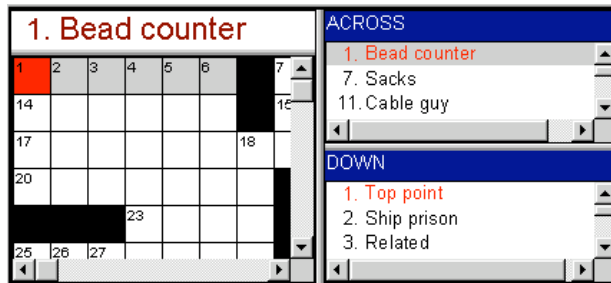
---

Take advantage of the computer's unique strengths

There is a wide range of ways that the computer can improve a game. Consider the [New York Times crossword puzzle online](#). At first glance this seems to be a literal translation of a paper and pencil puzzle. But the computer version has enough advantages that thousands of subscribers are willing to pay \$9.95 a year to play it.

**Convenient access.** Of course if you don't have a computer then computer puzzles are not convenient. But if you are already at your computer – for instance, at work – then it may be easier to click on your New York Times bookmark than to search for the latest paper issue. And it is much easier to search through previous puzzles online than in the physical paper.

**Improved interface.** Computer crossword puzzles have an arguably better interface. Click on a square and the definitions for the corresponding across and down words appear. You don't have to search a long list to find the definitions. On the other hand you can't see all the definitions at once – this is one place the newspaper has an advantage over the computer.



*Online crossword puzzles let you click a square to see the definitions.*

**Undo.** It is easier to backspace through a word on computer than it is to erase it on paper. The simple ability to undo a move is one of the main reasons the card game Solitaire is so popular on computer.

**Structured sequence.** An interesting side effect of putting a game on a computer is that it structures your experience in time. There is a clear beginning, middle and end, and the computer can keep track of your progress. I find that I am much more motivated to solve all the puzzles in a computer game than in a booklet accompanying a physical puzzle, or in a book of puzzles.

Now consider chess, a perennial best-seller as a computer game. Chess on computer has several advantages.

**Teach the rules.** One of the main reasons people buy computer versions of chess is to learn to play better. Most computer chess games include that teach the rules and basic strategy.

**Automated opponent.** If you have trouble finding someone to play with, computer chess is a good substitute. Automated opponents let you control the level of challenge. Even though the expert level of computer Boggle always beats me, I enjoy seeing the incredible words it finds.



*Chessmaster, an excellent computer chess game.*

**Algorithmically-generated puzzles.** A closely related feature is computer-generated puzzles. For instance the computer puzzle game [Pit Droids](#) from Lucas Learning includes a number of puzzles in the early levels that are generated algorithmically. Originally the game designers planned to generate all the puzzles algorithmically, but found that it is difficult to generate hard puzzles that are interesting to solve.

**Bells and whistles.** The computer game Battle Chess adds a nice gimmick: when one piece captures another, the pieces come to life and do battle. The gameplay is the same as normal chess, but the experience is different.

## Do something that can only be done on computer

As a puzzle designer, I'm particularly interested in inventing new types of puzzles that can only exist in the computer medium. The key question is what can computers do that no other medium can do?

[N'Sync Puzzles in Motion](#) shows how computers can give a traditional type of puzzle a new twist. Your goal is to assemble a jigsaw puzzle whose pieces are small rectangles of a music video that is in continuous motion. Since the picture doesn't stay still, it is much harder to figure out which piece goes next to which.



*N'Sync Puzzles in Motion is an animated jigsaw puzzle based on music videos*

Other examples of games that take unique advantage of the computer include the sonic puzzles in Myst, the game Tetris, and my two-fisted game [Double Maze](#) on the Segasoft web site.

## Conclusion

Learn from history, but don't be a slave to it. Question every aspect of a game when you translate it into the computer medium. Ask yourself: how will the limitations of the computer hurt the game? How can I change the game so it fits the computer medium better? How can I improve the game by exploiting the unique capabilities of the computer medium?