

Factor Master

Pitch

A Candy-Crush inspired game in which factors are matched to be removed from a grid.

Learning goals

Given a list of numbers, players should be able to identify which numbers are factors of one another.

After playing our game, the player should be able to identify the factors of a number.

Players should be able to answer the following questions, in increasing difficulty:

Q: Which of these are a factor of 16? 2, 5, 9

A: 2

Q: Which of these are factors of 56? 4, 7, 8, 9, 12

A: 4, 7, 8

Q: Give two factors of 72.

A: 9, 8

Educational Element

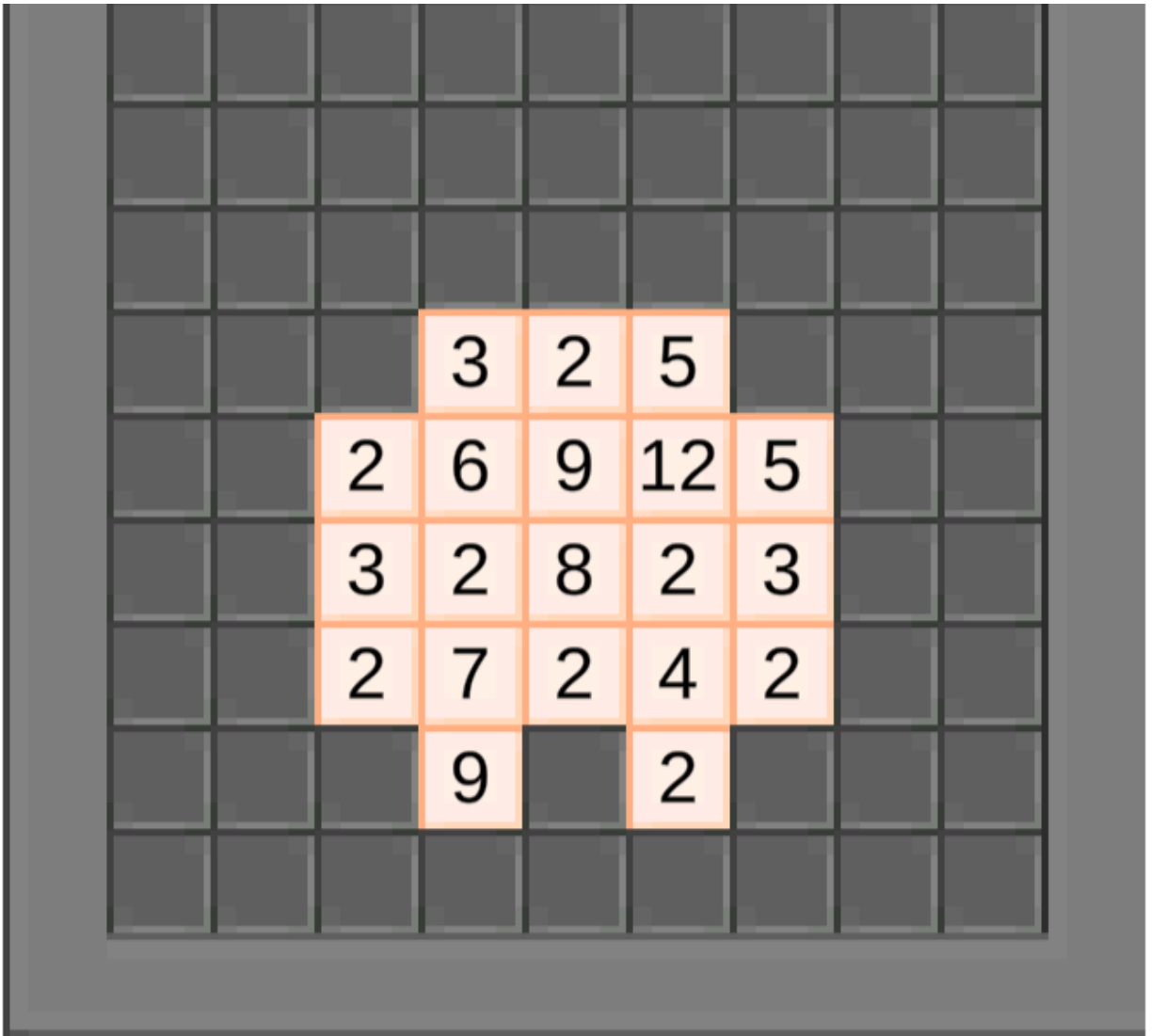
The gameplay promotes seeking and recognizing factors of numbers. If a player sees a 15 tile on the grid, they may recognize that 3 and 5 are valid factors, and check if either of those numbers are adjacent to the 15 tile. If they do not recognize it, they may do mental math to see if any adjacent tiles are factors, rewarded with the tiles clearing if the factors were identified correctly, and provided with feedback that the numbers are not factors, if they are not.

Gameplay Mechanics

- Number Tiles
 - The game will take place on a grid of number tiles ranging from 2 to 98. Larger primes and multiples of larger primes are excluded from the game.
 - By dragging the cursor, players will be able to select multiple number tiles. If the number tiles are chosen in a way such that all the numbers except the largest number multiply to the largest number, they will merge and factor. For instance, if 2 and 4 are chosen, the tiles will merge and factor to 2. If 2, 4, and 8 are chosen, the tiles will merge and factor to 2.
 - If the tiles factor to 1, the tile will disappear.
- Powerup Tiles
 - When three tiles are grouped together, a powerup tile will spawn. It behaves like a normal number tile.
 - When a powerup tile is used as a factor, it should clear the whole vertical and horizontal rows.
- Barrier Tiles
 - Higher levels will have barrier tiles which cannot be factored. The only way to remove these are by either using a powerup, or by factoring tiles near the barrier. This works similarly to a mechanic in Candy Crush.
- Win Condition
 - The tutorial levels will have a different win condition than the upper levels. The tutorial levels may be passed if the player makes any successful move, or if every single tile is cleared. For the upper levels however, the player can win only if they remove every single barrier tile on the map.

Game Aesthetics

Simple, minimalistic aesthetic like 2048.

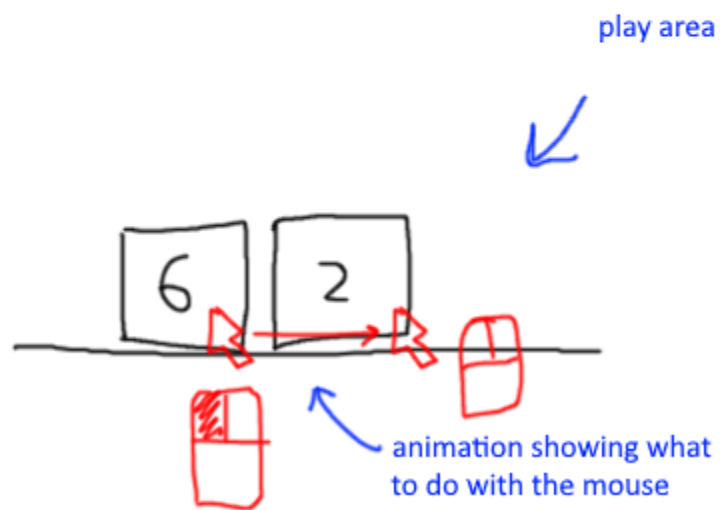


Level design

Level 1:

Level 1

drag your mouse to group the two tiles together!



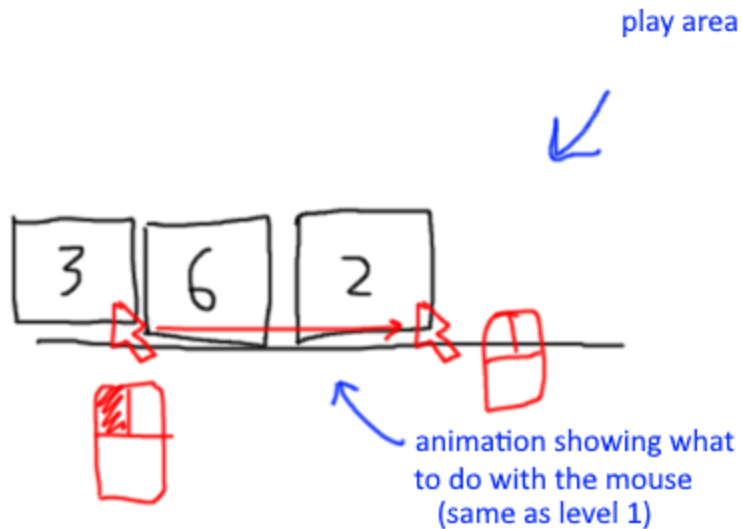
Things learnt:

- Math Education:
 - 2 is a factor of 6.
 - $6 / 2 = 3$
- Gameplay:
 - Drag the mouse to group tiles together
 - The remaining factor is left

Level 2:

Level 2

drag your mouse to group the three tiles together!



Things learnt:

- Math Education:
 - 2, 3 are factors of 6.
 - $6 = 2 * 3$
- Gameplay:
 - You can group more than two tiles together
 - When the remaining factor is 1, the tile disappears

Notes:

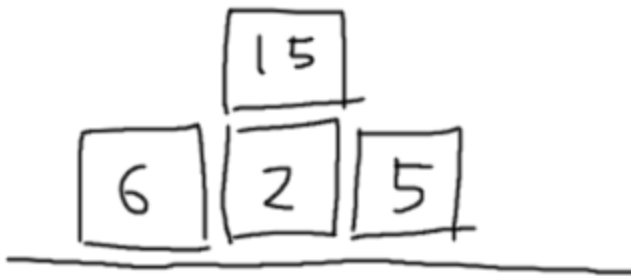
- It is impossible to softlock at this level. Choosing not to follow instructions and factoring only two numbers will still let you finish the level by factoring the others.

Level 3:

Level 3

make all the tiles disappear!

no tutorial animation
for this level; perhaps
one should pop up
when the player
takes a long time
to solve



Things learnt:

- Math Education:
 - 2 is a factor of 6
 - 3, 5 are factors of 15
- Gameplay:
 - Tiles will fall if there is nothing under
 - You can't select everything to clear the level

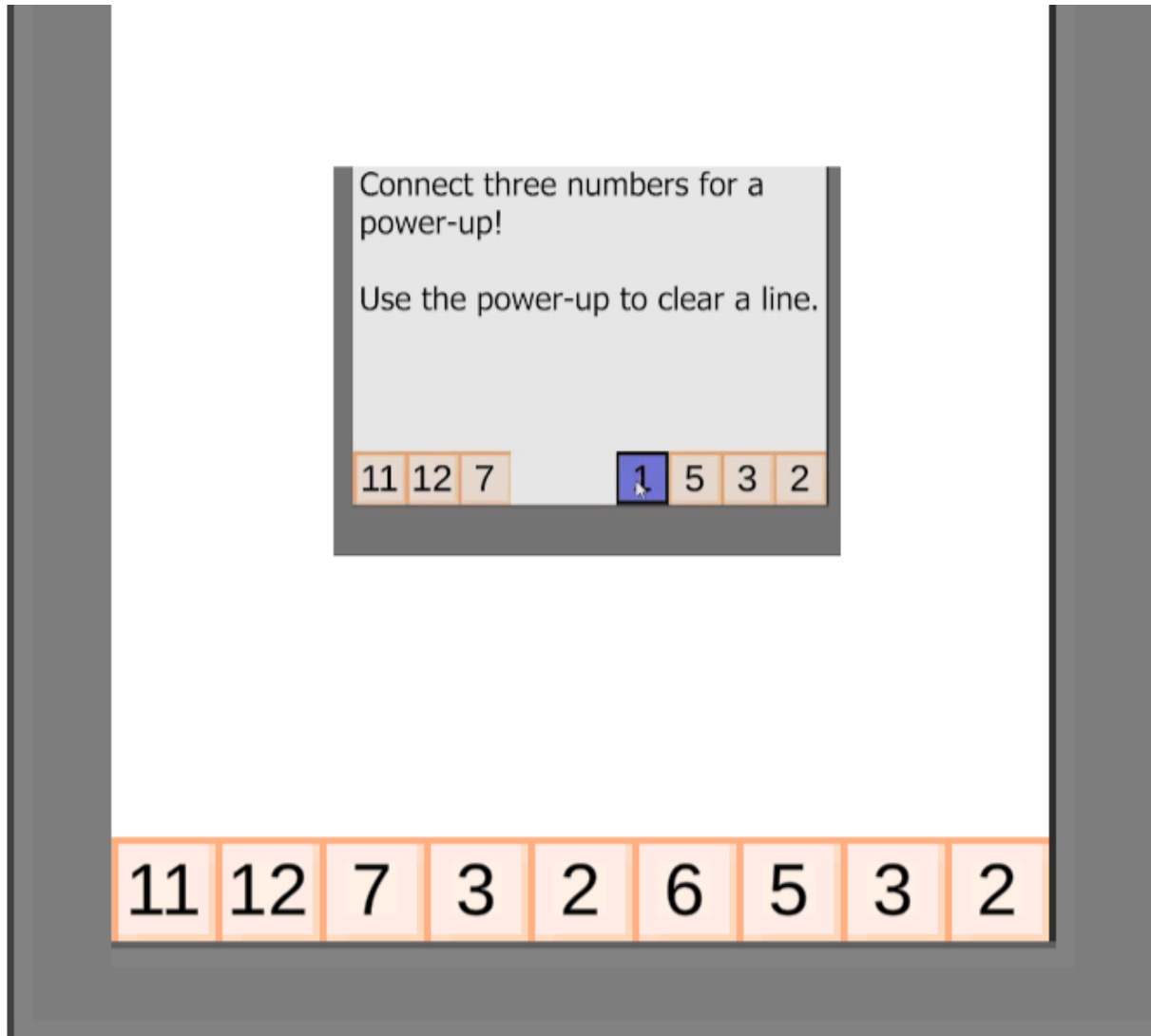
Notes:

- It is impossible to softlock at this level.
- The only valid first step is grouping the 6 and 2 together. This lets the player know that you can't select everything to win the level (not that you can select everything since it is in a T shape)
- I was hoping that players would recognize the 6 and 2 from the previous levels. Students that do not understand factoring well may not understand that selecting everything does not work, but

may remember that grouping the 6 and 2 together worked at a precious level and thus will work here as well. Once players get past that, any move is valid.

- This is the last *real* tutorial level for how to actually play the game, the rest of the tutorials are there to reinforce the player's understanding of playing the game.

Level 4



Things learnt:

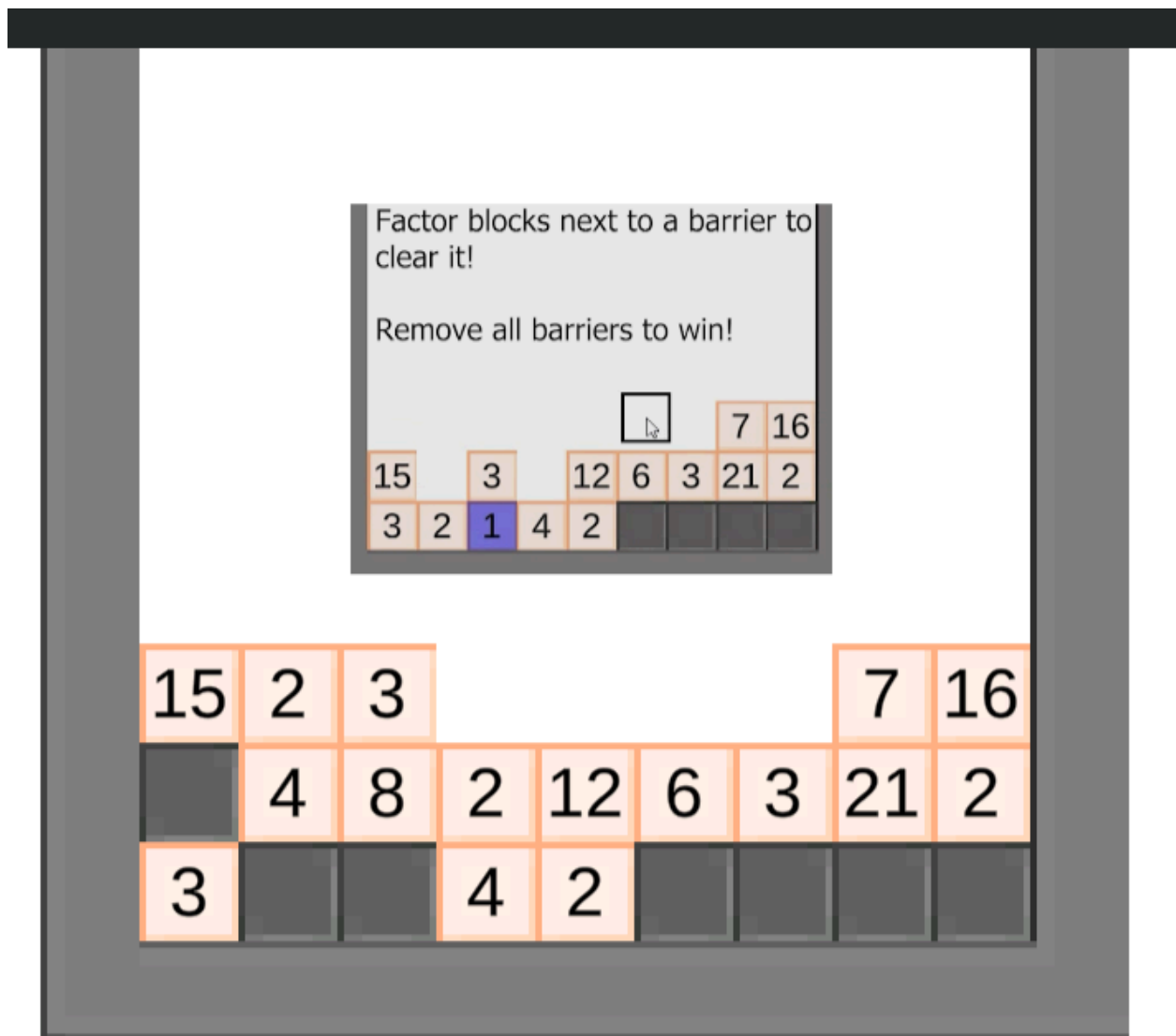
- Math education:
 - $3 * 2 = 6$
- Gameplay:

- You can connect multiple tiles to create a powerup
- Powerup line clearing mechanic (see below)

Notes:

- This is the one level where it is technically possible to softlock. To prevent this, the game will drop additional tiles when necessary to “save” the player from this stuck position.
- 2, 3, 6 come up a lot in the tutorials, because I’m hoping that players would recognize those numbers and factor them to first learn the gameplay mechanics

Level 5



Things learnt:

- Math Education:
 - How to factor various numbers other than 2, 3, 6
- Gameplay:
 - Barrier mechanic (unfactorable tiles which disappear when tiles nearby are factored)
 - First level where you can take multiple paths to complete the level

Notes:

- Every possible move has been tested to ensure softlocks cannot happen, which was difficult on a more complex level with many possibilities.
- Larger numbers which can be factored show up for the first time here

Communication

- How will the player know what to do / how to do it?
 - A series of tutorial levels will teach the player how to play the game. These tutorial levels would each teach a new concept, and allow players to use what they have learnt to clear a level.
 - For the first few levels, alongside a text explaining what to do, there will be an animation showing the player where they should drag with their mouse pointer to clear the level.
- How will the player know when they're doing things right or wrong?
 - When the player correctly groups numbers together such that the largest number can be factorized by the remaining numbers, the tiles will disappear showing the player that they have correctly identified the factors. When the player makes an incorrect grouping, the number tiles will shake and momentarily gain a red tint to indicate that something is incorrect.

Aesthetics

- What characters will you have (if any)?
 - There will be no characters in this game.
 - If time allows, I would like to add a character to accompany the player throughout the tutorial, and perhaps provide feedback when the player is stuck.
- What is the context / aesthetic that you're using for this game?
 - The aesthetic will be inspired by 2048 and Candy Crush.
- Polishing
 - When the tiles are grouped correctly, all the tiles will move towards the largest number in the group. The movement will be non-linear, and the tiles will accelerate and decelerate (acceleration will be linear so velocity will be parabolic). While moving the tiles will slightly rotate in the direction that they are moving in.
 - The smooth, satisfying feel of the merging of the tiles will make the game more enjoyable, and may result in the player playing the game longer.
 - When the tiles are grouped incorrectly the tiles will shake and be tinted red momentarily to tell the player that they have identified incorrect factors
 - SFX - Satisfying “popping” sounds should be present for when the tiles are factored correctly and disappear. When the tiles are factored incorrectly, a sound which sounds like an error message will be played. The error should be chosen carefully to prevent the user from feeling that they are being punished.

Development plan

[Moved to separate document](#)