

Shelf Life

Sort the library: every shelf one colour. Some volumes are tall, and only the tall shelves have room for them.

AT A GLANCE	
Genre	Hyper-casual sort puzzle; market references: Book Sort Master, Book Sort Puzzle, Colorwood Sort
Platforms	Portrait phones (Android) and the browser; Unity 6, URP
Controls	Tap a shelf to lift the books on its end, tap another to place them
Session	A level is 3 to 12 moves at best; no timer and no fail
Content	40 levels in 4 chapters of 10; up to 7 shelves and 5 colours
Status	Playable prototype 0.3.1: web build and Android APK; not yet tested with players



Level 4: the first tall volume



Level 21: the returns cart



Level 40: everything together

The core loop

- **Look:** which set is closest to done, and where can it finish?
- **Lift:** the run of one colour on a shelf's end.
- **Place:** onto the same colour or an empty shelf, if it fits.
- **Finish:** a full shelf of one colour turns gold; all done wins, stars for the fewest moves.

Who it is for

Players of sort puzzles who want a calm few minutes. The sort games studied sort by colour alone; height adds one more thing to read, and it reads at once because tall books look tall.

Design pillars

- **Readable at a glance.** A tall volume is a taller spine; a tall shelf has more headroom; a cart has wheels; a locked case has glass and a padlock.
- **One new idea per chapter,** brought in on an easy level.
- **No fail.** A dead end is named and restart is free.
- **No decoration.** A level's newest mechanic must change its best line; the generator checks it.

RULES

Shelves, heights, the cart and locked cases

Sorting

Shelves hold books in a row, 3 or 4 deep. Tap a shelf to lift the run of one colour on its right end, then tap another shelf: as many books as fit go across, onto the same colour or onto an empty shelf. Tap the lifted shelf again to put the books back. A shelf full of one colour is finished: its plank turns gold and nothing more can be taken.

Height

Shelves are low or tall. Some volumes in a colour set are tall, and any books that include a tall one fit only on a tall shelf, so a set with an atlas must finish on one of the few tall shelves. A run with a tall volume deep inside can still leave its short books on a low shelf, if only those fit.

Why mixed heights. Tried first: whole colours tall or short. The solver showed that rule never changed a best line when tall shelves were plentiful, and left almost every deal unsolvable when they were scarce (a tall set can only be dealt onto tall shelves, so it started finished).



The red run holds an atlas, so the low shelf can't take it

The returns cart

A trolley of returned books. Books can be taken from it but never put on it; it never finishes and has to end empty, so everything on it has to find a shelf.

Locked cases

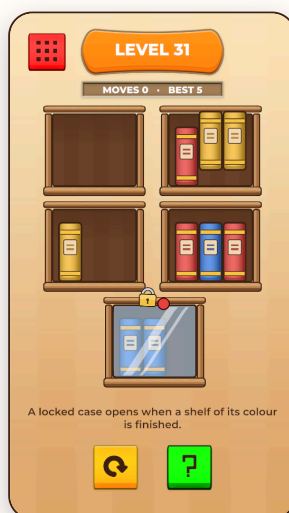
A glass case with a padlock and a tag in its key colour. Its books can't be taken and nothing can be added until a shelf of that colour is finished; on that move the padlock pops off. It never holds its own key colour.

Stars, hints, restart and dead ends

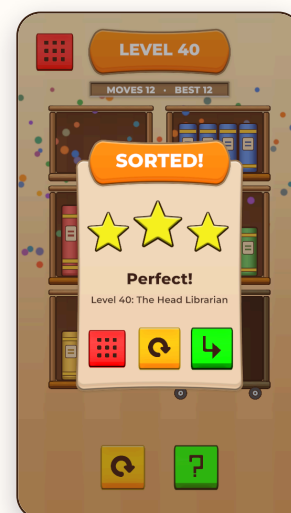
Each level's par is the solver's fewest moves: three stars at par, two within two moves of it, one otherwise. The hint shows the solver's next move from where the player is. When no legal move is left, the game says so and points at restart. There is no undo yet: it would make par reachable by trial and error, a choice to make after playtests.



The cart, on wheels



Locked until red is finished



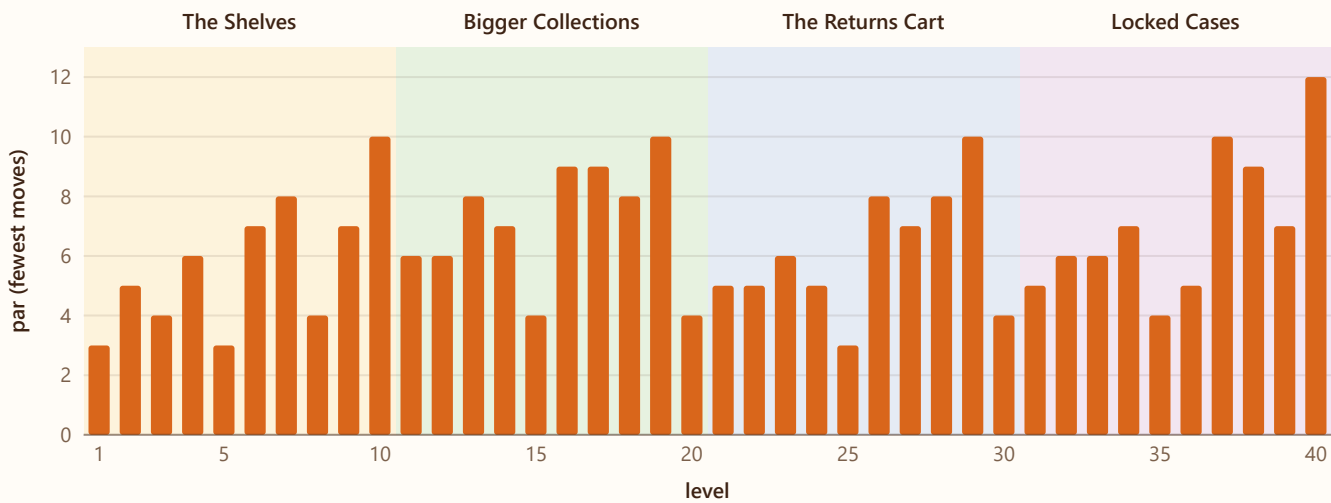
A win: stars by moves

Four chapters, one new idea each

Each chapter brings in one idea on an easy level, then builds on it. Within a chapter the best line climbs in a sawtooth, with a breather after the peaks.

CHAPTER	NEW IDEA	SHELVES	COLOURS	LEVELS WITH TALL VOLUMES	PAR
1. The Shelves	Sorting, then tall volumes from level 4	3–5	2–4	5	3–10
2. Bigger Collections	More colours, deeper shelves, more tall volumes	4–6	3–5	6	4–10
3. The Returns Cart	The returns cart	4–6	2–4	3	3–10
4. Locked Cases	Locked cases, then everything together	4–7	2–4	5	4–12

The difficulty curve: par per level



Par is a stand-in for difficulty, not a measure of it: the workbook adds what the bots show. Breathers (a drop of three moves or more): levels 5, 8, 11, 15, 20, 30, 35.

Teaching without a tutorial

A new idea gets a one-line tip on the level where it first appears, and level 1 shows a hand on the first shelf to tap.

LEVEL	THE ONE-LINE TIP
1	Tap a shelf to lift the books on its end, then tap where they go.
2	Books go onto the same colour, or onto an empty shelf.
4	A tall volume only fits on a tall shelf, and so does any run it is in.
11	More colours, deeper shelves. Plan where each set will end up.
21	The returns cart: take books off it, but nothing goes back on. Empty it to win.
31	A locked case opens when a shelf of its colour is finished.

How the levels are made and proven

1 • The spec: what I decide

Each level is one line in the plan: its shelves (low, tall, the cart, a locked case and its key), the colour sets with their tall volumes, the range its par must fall in, and its focus: the newest mechanic.

2 • The generator deals it

It deals the books at random (tall ones only where they fit, never a case's key colour into it) and keeps a deal only if:

- no shelf starts finished,
- the solver's best line falls inside the range,
- the focus mechanic changes the best line: the same deal with that rule switched off (every shelf tall, the cart an ordinary shelf, the cases open) needs a different number of moves.

3 • The solver proves it

A breadth-first search over every reachable board finds the fewest moves, the par. The same solver gives hints in the game.

The level file

Plain text, readable and editable by hand. Level 31, the first locked case:

```
=== 31 | Locked Case | par 5 | focus locked  
shelf 3 low:  
shelf 3 low: r y y  
shelf 3 low: y  
shelf 3 low: r b r  
shelf 3 low locked r: b b
```

Tests that guard the design

- Every level's par equals what the solver finds.
- No level starts with a finished shelf.
- Every level's focus mechanic changes its best line.
- The rules: runs carry as many as fit, tall volumes need tall shelves, the cart only gives, a case opens with its colour, a dead end has no move.
- A playthrough wins levels 1, 4, 21, 31 and 40 in the real scene and checks that refused moves cost nothing.

What the solver and the bots found

Shelf Life has not been tested with players yet. These findings come from the solver and from bots playing the real rules; each changed the design. What only people can show is listed at the end.

1 • Heights per colour did nothing

With whole sets tall or short, the height rule never changed a best line when tall shelves were plentiful, and almost every deal was unsolvable when they were scarce.

Change: mixed heights within a set; the generator now keeps a deal only if its focus mechanic changes the best line.

2 • An empty reserved shelf was decoration

The first lock was a shelf that started empty and opened once a colour was finished. In 500 random deals per layout it changed the best line in only a handful, and in none of the small layouts an easy introduction needs: by then the extra room rarely helps.

Change: the locked case: books trapped inside force an order. 16 to 123 of 500 deals now pass the focus check.

3 • The height rule's real job: dead ends

A greedy bot (it finishes a shelf when it can, otherwise plays at random) reaches a dead end, no legal move left, in 75–98% of its games on 9 of the 11 height levels (levels 14 and 18 stay open), against 0% on most plain ones. Two later levels, 29 (the cart) and 36 (a locked case), dead-end in every one of its games.

Change: the game names a dead end ("No moves left") and pulses the restart button, rather than leaving a frozen bookcase.

Still to learn from people

- Do players see a tall volume and plan for it, or only learn from the refusal?
- Do the padlock and its colour tag explain a locked case without the tip?
- Is a dead end with a restart fair, or does the game need undo?

Juice, art, monetisation and the roadmap

Game feel

- A lifted run rises; books fly to their new shelf in an arc, one after another, with a tick as each lands.
- A refused move shakes the shelf; a tall volume bumps against a low one; a locked case's padlock jumps.
- A finished shelf turns gold, its books hop in a wave, "Shelved!" pops in the set's colour.
- A case opening: the padlock pops off and the glass clears. A win rains confetti; stars pop in one by one.

Art and audio

The interface is SunGraphica's Casual Mobile Game UI Kit (free version): parchment frames, ribbon headers, chunky buttons with dark outlines. The books, shelves, cart and cases are drawn in code in the same style: bright spines with gold bands and a label, warm wood, a dark brown outline. Type is Montserrat; sounds are Kenney's.

Built with

Unity 6 (URP). The rules live in a pure C# library with no engine code, mirrored in a Python tool that generates, probes and measures the levels. Built with an AI coding assistant (Claude): I set the rules, the mechanics, the chapter plan and the tuning, reviewed every build and decided each change.

Monetisation (a plan, not built)

The prototype has no ads or purchases. As a hyper-casual release it would follow the genre:

- **Interstitials** between levels, never mid-level, not in the first chapter.
- **Rewarded extra shelf:** at a dead end, a rewarded ad adds an empty shelf for this level.
- **Rewarded hint** after a free one per level; **remove ads** as one purchase.

What to measure first

- Dead ends and restarts per level: are the bots' walls walls for people too?
- Refused moves by reason on levels 4, 21 and 31: is each rule understood?
- Day-1 retention and the level where players stop.

Roadmap

- Playtests with first-time players; decide on undo from what they show.
- Retune the walls the bots found (levels 29 and 36) if people find them walls too.
- A visual level editor in Unity on top of the generator and solver.

Credits

Interface: Casual Mobile Game UI Kit by SunGraphica (sungraphica.itch.io). Sounds and pointer: Kenney (kenney.nl, CC0). Font: Montserrat (SIL Open Font License).