



Knitting a Reverse Bob Minimus

Skill and Experience 

This is a piece of knitting for a more experienced knitter, but it is not very difficult and there are two videos to help you.

How it relates to maths

The art of change ringing started in England in the late 1500's. Bells in churches hung on wheels can be rung by pulling on a rope, but once they are swinging you can only slow them down or speed them up a little. This means that if bells are rung one after another, they can only swap places with adjacent bells. If each bell is given a number this means that 1 2 3 4 5 6 can be followed by 2 1 3 4 6 5 because 1 and 2 have changed places and 5 and 6 have changed places. But 1 2 3 4 5 6 could not be followed by 2 3 1 4 5 6 because bell 1 could not get all the way over to the 3rd place in one go.

In mathematics we call 2 3 1 a permutation of the three number 1, 2 and 3. There are 6 permutations of three numbers:

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 1 | 2 | 3 |
| 1 | 3 | 2 | 1 | 3 | 2 |
| 2 | 1 | 3 | 2 | 1 | 3 |
| 2 | 3 | 1 | 2 | 3 | 1 |
| 3 | 1 | 2 | 3 | 1 | 2 |
| 3 | 2 | 1 | 3 | 2 | 1 |

But this sequence could not be rung on three bells because bell 2 jumps from place 3 to place 1 in the third line.

A possible sequence of the 3 bells would be:

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 1 | 2 | 3 |
| 1 | 3 | 2 | 1 | 3 | 2 |
| 3 | 1 | 2 | 3 | 1 | 2 |
| 3 | 2 | 1 | 3 | 2 | 1 |
| 2 | 3 | 1 | 2 | 3 | 1 |
| 2 | 1 | 3 | 2 | 1 | 3 |

Notice that this would also allow the bells to return to the original order of 1 2 3 at the end without breaking the rules.

An extent is a sequence which obeys the rules and has every permutation of the bells without any repetition (except that it ends with the order with which it began). There are $7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5040$ permutations of 7 bells, and it takes about 3 hours to ring an extent on 7 bells. Crediton church has 12 bells. How long, roughly, would it take to ring an extent on all 12 bells?

The shape the bells follow through time as shown by the coloured lines in the example above makes me think of cable knitting. Cable knitting is usually made in one colour, but when worked in 4 colours to represent an extent of 4 bells it makes a very attractive pattern and shows all 24 possible permutations of 4 items.



This one is based on a reverse bob minimus as defined by the Central Council of Church Bell Ringers here:

[Microsoft Word - ac minimus.doc \(ccabr.org.uk\)](#).

If you want to find out more about bell ringing you might like to look at [Introduction to Change-ringing](#) or [Ringing the changes](#)



What you'll need



5 mm knitting
needles



5 mm cable
needle



300g of a
neutral coloured
Aran weight yarn



100g each of red,
yellow, green and
blue Aran weight yarn



A copy of the
"Reverse Bob
cable pattern"



Pen or
pencil



Scissors



A tapestry,
darning or
wool needle

Step-by-Step Instructions

There are two videos
to help you called
"Colour Cable Knitting"
& "Colours Crossing"

- 1** Print out the Reverse Bob cable pattern at a size where you can see it and mark off which rows you have done.
- 2** Cast on 43 stitches in neutral and work eight rows in moss stitch starting with a knit and slipping the last stitch for each row.
- 3** Put the paper version of the pattern beside you with the 1st row nearest you (so it looks as if it is upside down).
- 4** The next row will be working the first front row of the pattern: knit 1, purl 1, knit 1, purl 1, knit 1.
- 5** Purl in the back and the front of the next stitch, purl the next stitch, purl in the back and the front of the next stitch, purl the next stitch, purl in the back and the front of the next stitch (so there are now eight stitches where there used to be five).
- 6** Pick up the red yarn and knit in red in the back and front of the next two stitches (so there are four where there used to be two). Pick up the neutral yarn at the back and follow instruction 5 again.
- 7** Pick up the blue yarn and knit in blue in the back and front of the next two stitches (so there are four where there used to be two). Pick up the neutral yarn at the back and follow instruction 5 again.
- 8** Pick up the yellow yarn and knit in yellow in the back and front of the next two stitches (so there are four where there used to be two). Pick up the neutral yarn at the back and follow instruction 5 again.
- 9** Pick up the green yarn and knit in green in the back and front of the next two stitches (so there are four where there used to be two). Pick up the neutral yarn at the back and follow instruction 5 again.
- 10** Knit 1, purl 1, knit 1, purl 1 and slip the last stitch. You should now have 66 stitches on your needle.
- 11** Now the first back row of the pattern: in neutral, knit 1, purl 1, knit 1, purl 1, knit 1. Knit eight in neutral. Hold the neutral working yarn along the front of the left-hand needle (which is the back of the scarf) and bring the red working yarn to the front between the needles (this is to twist the different yarns together so you don't get holes in your work. You can drop the yarn held by the left-hand needle as soon as you start working with the new colour). Purl four in red. Hold the red working yarn along the front of the left-hand needle and knit eight in neutral. Hold the neutral working yarn along the front of the left-hand needle, bring the blue yarn to the front and purl four in blue. Continuing to hold the previous coloured yarn along the front of the left-hand needle, knit eight in neutral. Purl four in yellow. Knit eight in neutral. Purl four in green. Knit eight in neutral, then knit 1, purl 1, knit 1, purl 1 and slip the last stitch.
- 12** Mark the first row as complete on your pattern.
- 13** Looking at the pattern you can see that the next seven double rows are just the same. For each double row, when you are working on the front, work five moss stitches starting with a knit, then purl until you come to a coloured stitch. Hold the neutral working yarn along the back of the left-hand needle. Knit four stitches in the colour then hold the coloured working yarn along the back of the left-hand needle as you change back to neutral and purl until the next colour. After the 4th coloured four knitted stitches, purl in neutral until you come to the last five stitches which are always knit 1, purl 1, knit 1, purl 1 and slip the last stitch.
- 14** For a row where you are working on the back, work five moss stitches starting with a knit, then knit until you come to a coloured stitch. Hold the neutral working yarn along the front of the left-hand needle (which is the back of the scarf). Purl four stitches in the colour then hold the coloured working yarn along the front of the left-hand needle as you change back to neutral and knit until the next colour. After the 4th coloured four purled stitches, knit in neutral until you come to the last five stitches which are always knit 1, purl 1, knit 1, purl 1 and slip the last stitch. When you finish a double row, mark it as complete on the pattern.



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- 15** Double row nine has the first movement of the colours. Looking at the pattern you can see that the green and yellow cables need to move one square (two stitches) closer to each other and the red and blue cables need to move one square (two stitches) closer to each other. So, in neutral, knit 1, purl 1, knit 1, purl 1, knit 1. Knit eight in neutral.
- 16** Slip the four red stitches onto a cable needle pulled to the front of the work. Purl two stitches in neutral behind the cable needle. Hold the neutral working yarn along the back of the cable needle. Push the four red stitches to the opposite end of the cable needle to the end they went on and knit them, in red yarn, onto the right-hand needle, letting go of the neutral yarn after you have picked up the red. Put the cable needle to one side, hold the red yarn along the back of the left-hand needle and bring the neutral yarn to the front to purl four stitches. Slip the next two neutral stitches onto the cable needle pulled to the back of the work. Hold the neutral working yarn along the back of the left-hand needle. Find the blue yarn and knit the four blue stitches in front of the cable needle. Hold the blue working yarn along the back of the cable needle. Push the two neutral stitches to the opposite end of the cable needle to the end they went on and purl them, in neutral yarn, onto the right-hand needle, letting go of the blue yarn after you have picked up the neutral and brought it to the front. Put the cable needle to one side.
- 17** Purl eight neutral stitches, then repeat instruction 16 but working yellow rather than red and green rather than blue. Then purl eight more neutral stitches, the knit 1, purl 1, knit 1, purl 1 and slip the last stitch.
- 18** The second half of double row nine is on the back of the scarf, so work it as in instruction 14.
- 19** Double row 10 moves the colours in the same way as double rows nine so you can use the instructions above and the pattern to work out how to do these. You should end up with no neutral yarn between red and blue or between yellow and green.
- 20** In double row 11 the colours have switched over. The grey row in the pattern is not a knitted row but shows you that red goes over blue and yellow goes over green. For the front row, work five moss stitches then purl in neutral until you come to the red stitches. Red goes over blue, so slip the four red stitches onto the cable needle pulled to the front of the work. Hold the neutral working yarn along the back of the left-hand needle and pick up the blue yarn. Work four knit stitches. Push the four red stitches to the opposite end of the cable needle to the end they went on. Hold the blue working yarn along the back of the cable needle and knit the four red stitches from the cable needle to the right-hand needle in red yarn. Hold the red working yarn along the back of the left-hand needle and bring the neutral yarn to the front to purl up as far as the yellow stitches. Use the same technique as above to cross the yellow over the green, then purl in neutral until the last five stitches which are, as always, knit 1, purl 1, knit 1, purl 1 and slip the last stitch.
- 21** Continue like this, using the pattern to see when to move the cable lines. You should find you alternate between five double rows where you need the cable needle and five double rows where nothing moves. This continues until double row 244 when there are eight double rows when nothing moves.
- 22** When you have completed the 251st double row, the next row is in neutral yarn moss stitch. Knit 1, purl 1, knit 1, purl 1, knit 1, purl 2 together, knit 1, purl 2 together, knit 1, purl 2 together. You should now be up to the red stitches. Knit 2 together, purl 2 together, knit 2 together, purl 1, knit 2 together, purl 1, knit 2 together. You should now be up to the blue stitches. Purl 2 together, knit 2 together, purl 2 together, knit 1, purl 2 together, knit 1, purl 2 together. You should now be up to the yellow stitches. Knit 2 together, purl 2 together, knit 2 together, purl 1, knit 2 together, purl 1, knit 2 together. You should now be up to the green stitches. Purl 2 together, knit 2 together, purl 2 together, knit 1, purl 2 together, knit 1, purl 2 together. Knit 1, purl 1, knit 1, purl 1 and slip the last stitch. There should now be 43 stitches on the needle.
- 23** Work seven more rows in moss stitch and cast off.
- 24** Sew in all ends, using the coloured yarn ends to neaten up the start and finish of the cable lines.

Quick Tips



I used "Caron Simply Soft" in Bone, Autumn Red, Gold, Dark Sage and Dark Country Blue. The scarf could also be made in double knit with 4mm needles.

Each row in the pattern is two rows of work, one with the front towards you and one with the back towards you. Each column in the pattern is two stitches of work.

I printed the pattern out on six A4 pages so I could count things easily and used one column to mark where I was every time I finished a double row.

All changes are done first on the front, where the cables show. The neutral background is always purled on the front and knitted on the back. The cables are always knitted on the front and purled on the back. The edges are always in moss stitch starting with a knit.

Keep your stitches quite firm when changing colours so that you don't get loops in your work. The original ends can be sewn in at the end and can cover up any unsymmetrical bits at the start.

At instruction 15 things start to get a bit complicated so there is a video showing how to move the cables called "[colour cable knitting](#)". Instruction 20 is about "[colours crossing](#)" so there is also a video for that.

At the end of every double row, sort out your working yarn. You may have to untangle some of the balls now and then!

