

Hybrid parallel programming and DP – hands-on examples

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July 25th, 2019

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Including adapted teaching material from books, lectures and presentations by
B. Barney, B. Cumming, W. Gropp, G. Hager, M. Martinasso, R. Rabenseifner, O. Schenk, G. Wellein

Outline

I. Dynamic programming

- OMP & MPI
- MPI groups

1. recall – the model

$$V_{new}(k, \Theta) = \max_c (u(c) + \beta \mathbb{E}\{V_{old}(k_{next}, \Theta_{next})\})$$

$$\text{s.t. } k_{next} = f(k, \Theta_{next}) - c$$

$$\Theta_{next} = g(\Theta)$$

States of the model:

- k : today's capital stock → **There are many independent k 's**
- Θ : today's productivity state → **The Θ 's are independent**

Choices of the model:

- k_{next}

→ k , k_{next} , Θ and Θ_{next} are limited to a finite number of values

solver.cpp – the critical loops

```
for (int itheta=0; itheta<ntheta; itheta++) {
```

2). *split MPI communicator

```
/*  
Given the theta state, we now determine the new values and optimal policies corresponding to each  
capital state.  
*/
```

```
for (int ik=0; ik<nk; ik++) {
```

1). distribute k's via OpenMP & MPI

loops to worry about

```
// Compute the consumption quantities implied by each policy choice  
c=f(kgrid(ik), thetagrid(itheta))-kgrid;
```

```
// Compute the list of values implied implied by each policy choice  
temp=util(c) + beta*ValOld*p(thetagrid(itheta));
```

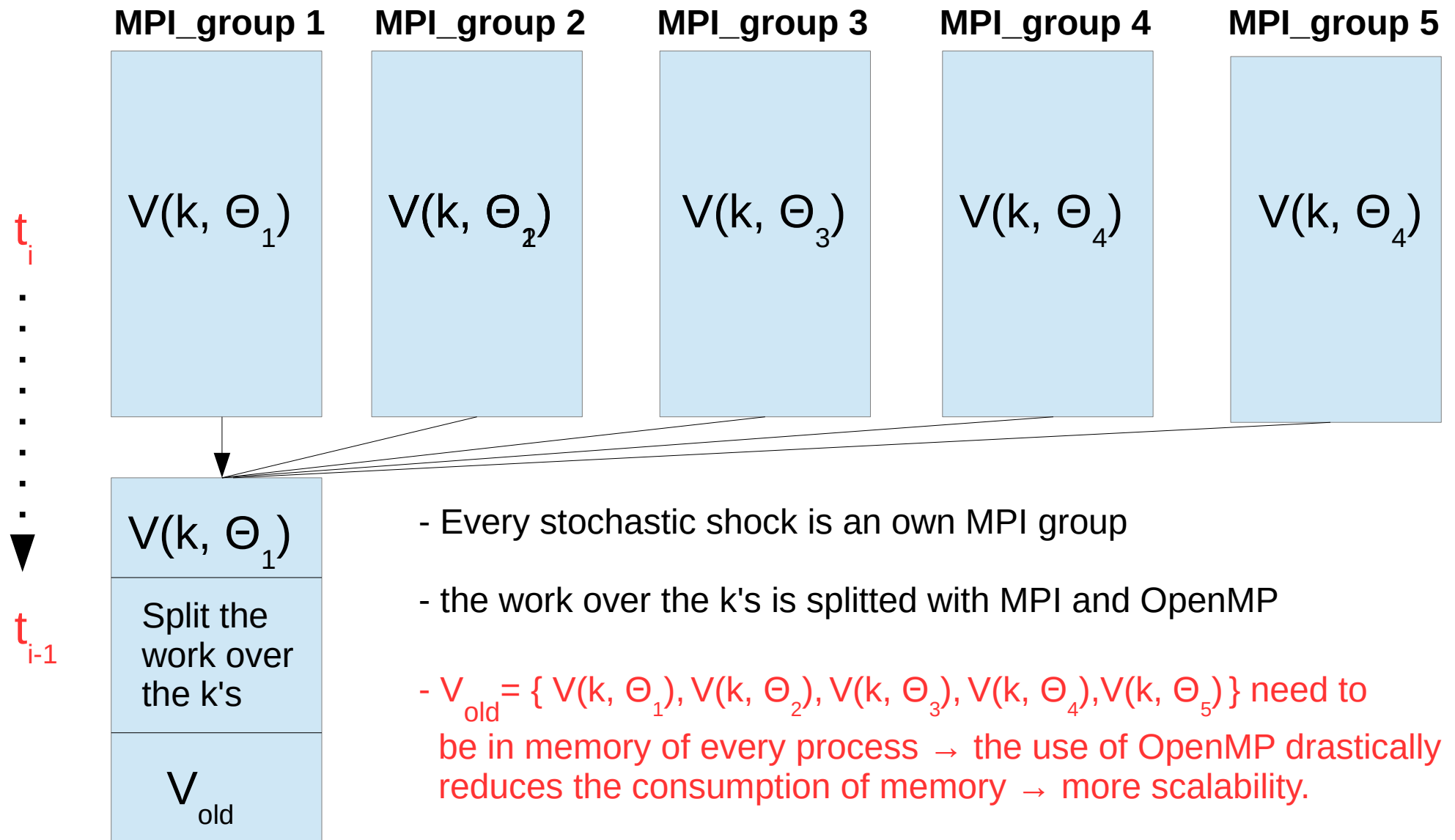
```
/* Take the max of temp and store its location.  
The max is the new value corresponding to (ik, itheta).  
The location corresponds to the index of the optimal policy choice in kgrid.  
*/
```

```
ValNew(ik, itheta)=temp.maxCoeff(&maxIndex);
```

```
Policy(ik, itheta)=kgrid(maxIndex);
```

```
    }  
}
```

The parallelization scheme



Let's do that together in class

1) OMP & MPI

2) MPI groups